Ending Elementary Errors of the British Maths Era

1522 – 2022

INTERNATIONAL CONFERENCE ON HISTORY OF MATHEMATICS

CENTRE FOR INDIAN KNOWLEDGE SYSTEMS, IIT MADRAS

in association with

INDIAN SOCIETY FOR HISTORY OF MATHEMATICS

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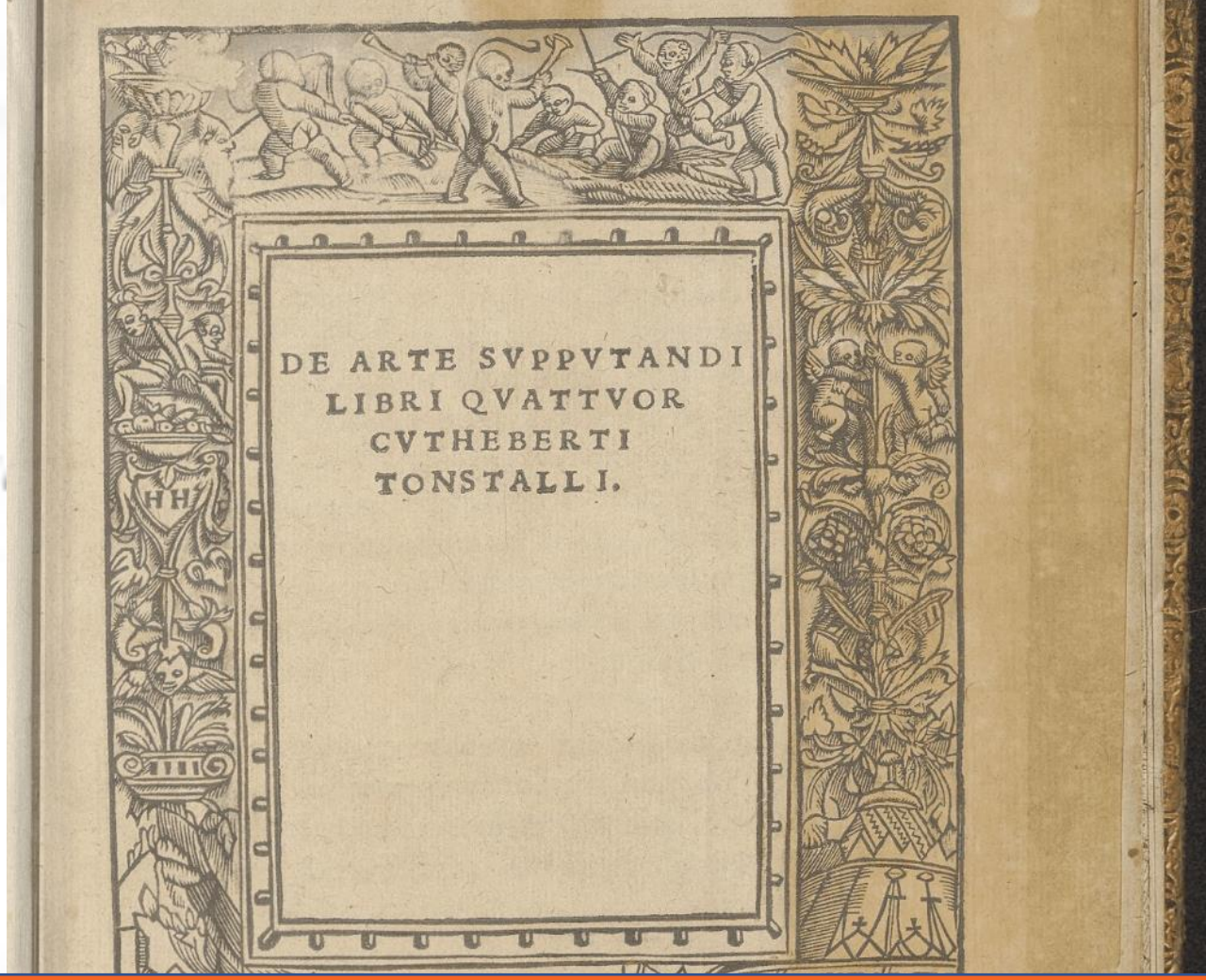
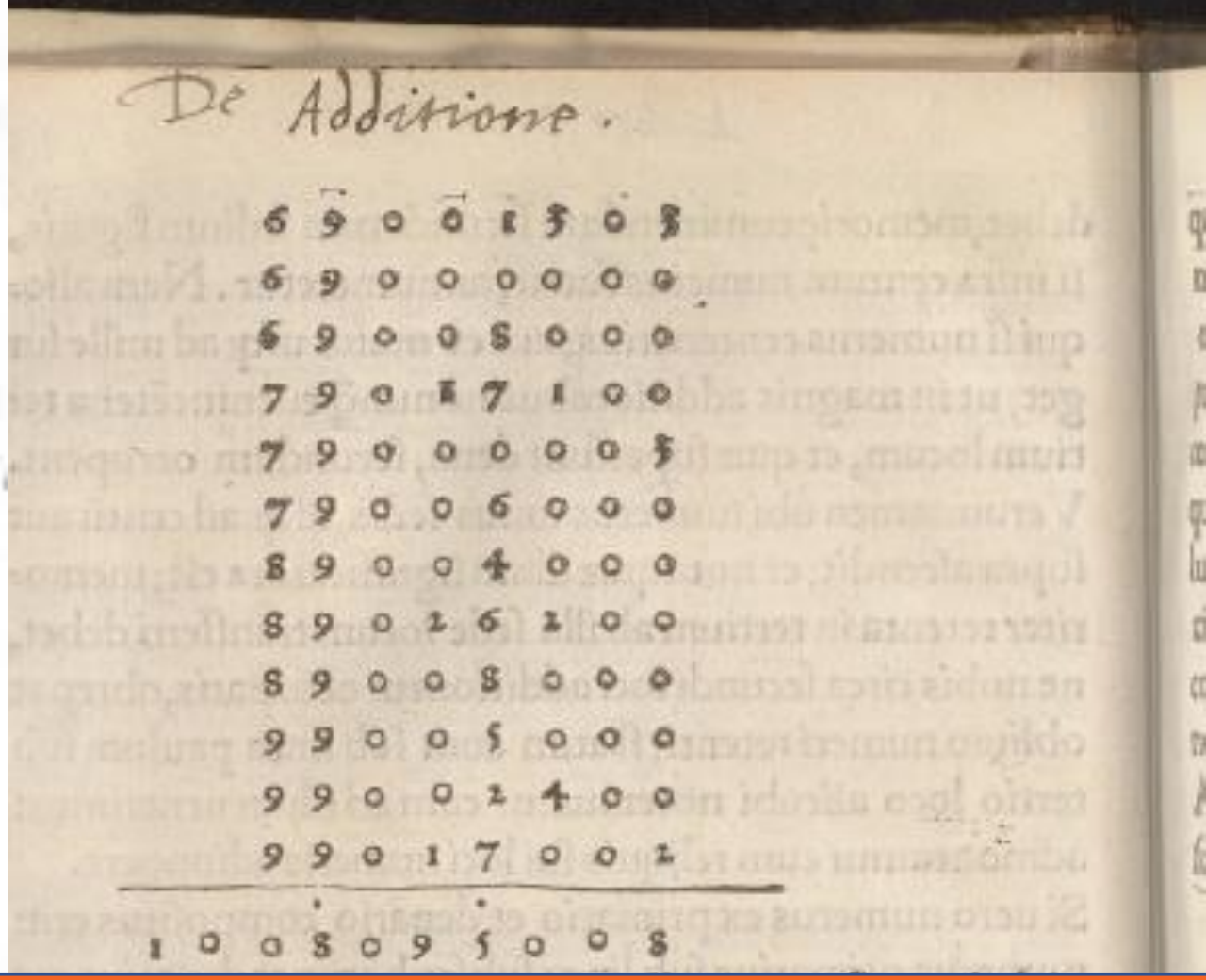


DE ARTE SUPPUTANDI LIBRI QUATTUOR
The Art of Calculation in Four Books
By Catholic Priest Cuthbert Tunstall 1522



A week later King Henry VIII made Tunstall Bishop of London. Tunstall was at the end of a series of ideas copied from others…

1494

- **Luca Pacioli**
- Summa de arithmetica, geometria, proportioni et proportionalità

c.1475

- **Piero della Francesca**
- Trattato d'abaco

1202

- **Leonardo Pisano**
- Liber Abaci

1494

- **Luca Pacioli**
- Summa de arithmetica, geometria, proportioni et proportionalità

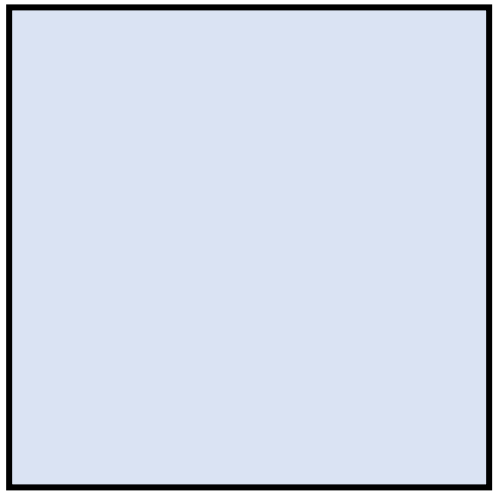
Luca Pacioli on (10 – 2) × (10 – 2)

NOTE Below the m̃ means today's – symbol

"10 m̃ 2 equals 8; this means that if 10 m̃ 2 is multiplied by 10 m̃ 2 the result is 64; if however, the cross multiplication is applied, we obtain 10 multiplied by 10, namely 100, then 10 twice multiplied by m̃ 2, which gives m̃ 40, which together give 60; thus it becomes evident that m̃ 2 multiplied by m̃ 2 should give the number 4."

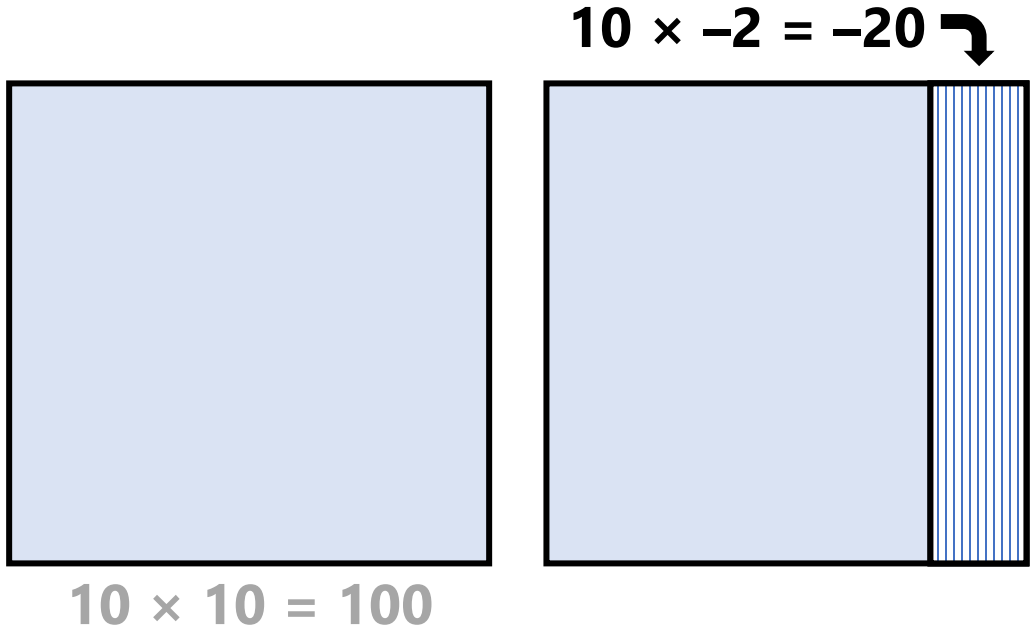
Juschkewitsch, A. P.: 1964, *Geschichte der Mathematik in Mittelalter*, ubersetzt von V. Ziegler. Basel: Pfalz-Verlag. Trans. In Thomaidis Y. (1993). *Aspects of negative numbers in the early 17th century : an approach for didactic reasons.* Science & Education : Contributions from History Philosophy and Sociology of Science and Mathematics 69–86.

Luca Pacioli on (10 – 2) × (10 – 2)

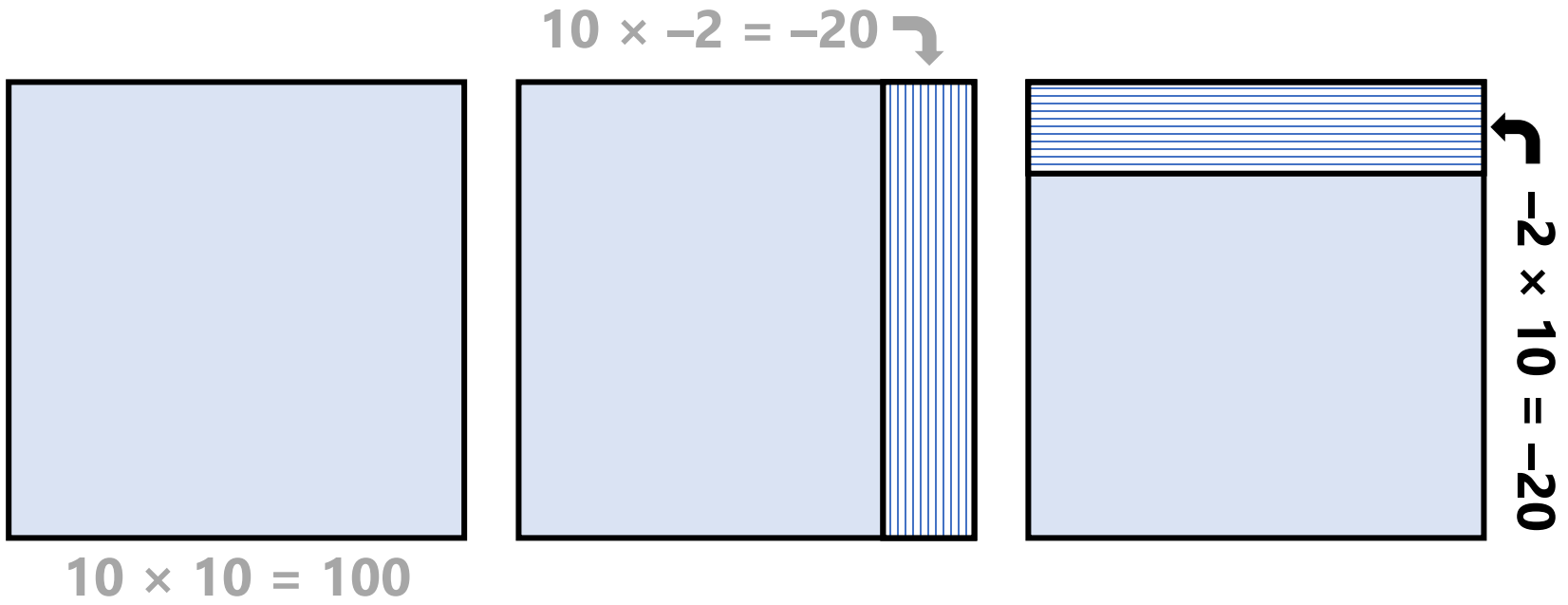


10 × 10 = 100

Luca Pacioli on (10 – 2) × (10 – 2)



Luca Pacioli on (10 – 2) × (10 – 2)



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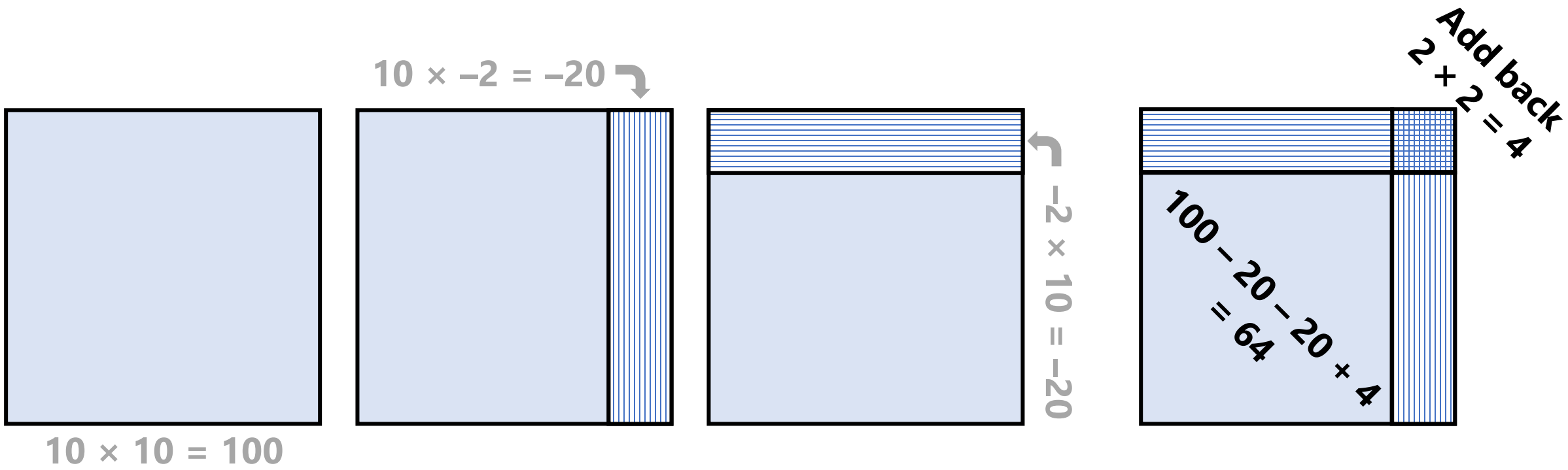
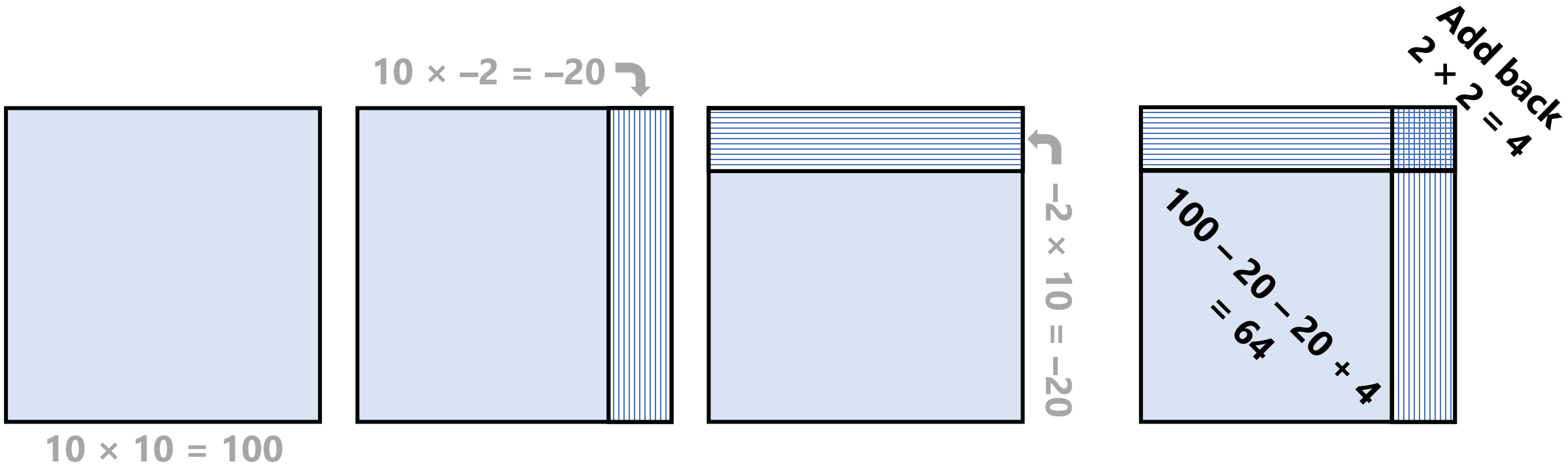


The top right corner measuring 2 × 2 was removed twice instead of once, so it must be added back once!

Luca Pacioli on (10 – 2) × (10 – 2)



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There are no negative numbers in (10 – 2) × (10 – 2).
There are just positive numbers being subtracted.

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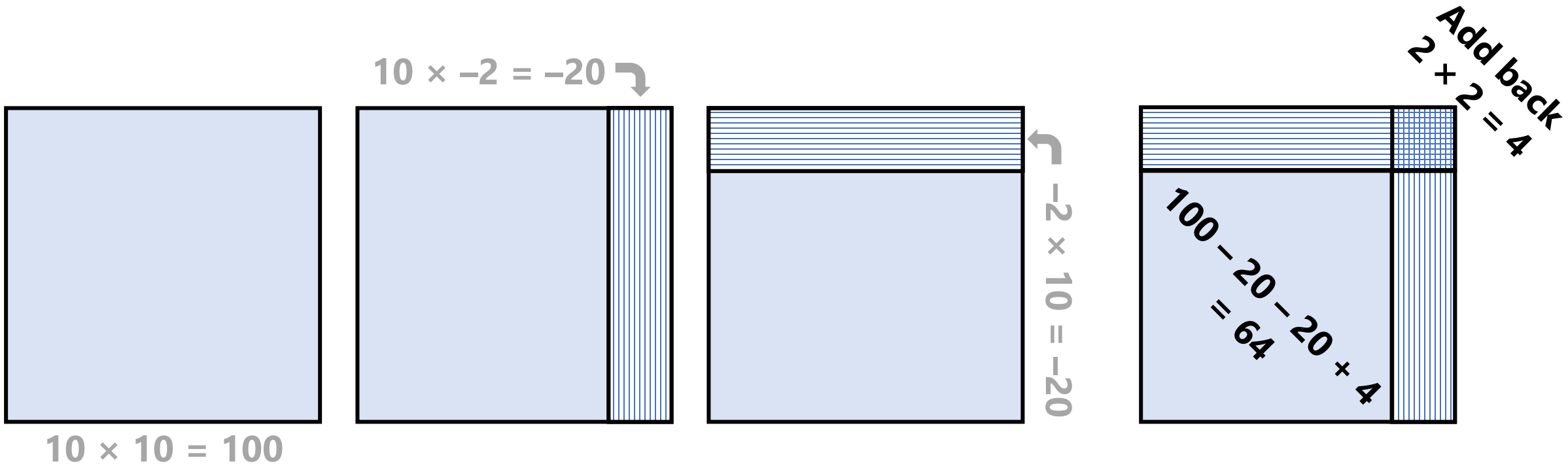

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There are no negative numbers in (10 – 2) × (10 – 2).
There are just positive numbers being subtracted.

For $^{-}8 \times {}^{-}8$ we would need (2 – 10) × (2 – 10).

1494

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- Summa de arithmetica, geometria, proportioni et proportionalità

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- **Leonardo Pisano**
- Liber Abaci

c. 825

- **Al-Khwārizmī**
- Al-Khwārizmī's Algoritmi de numero Indorum (The Hindu Art of Reckoning)

628

- **Brahmagupta**
- Brāhmasphuṭasiddhānta

c. 825

- **Al-Khwārizmī**
- Al-Khwārizmī's Algoritmi de numero Indorum (Latin translation of the Arabic)

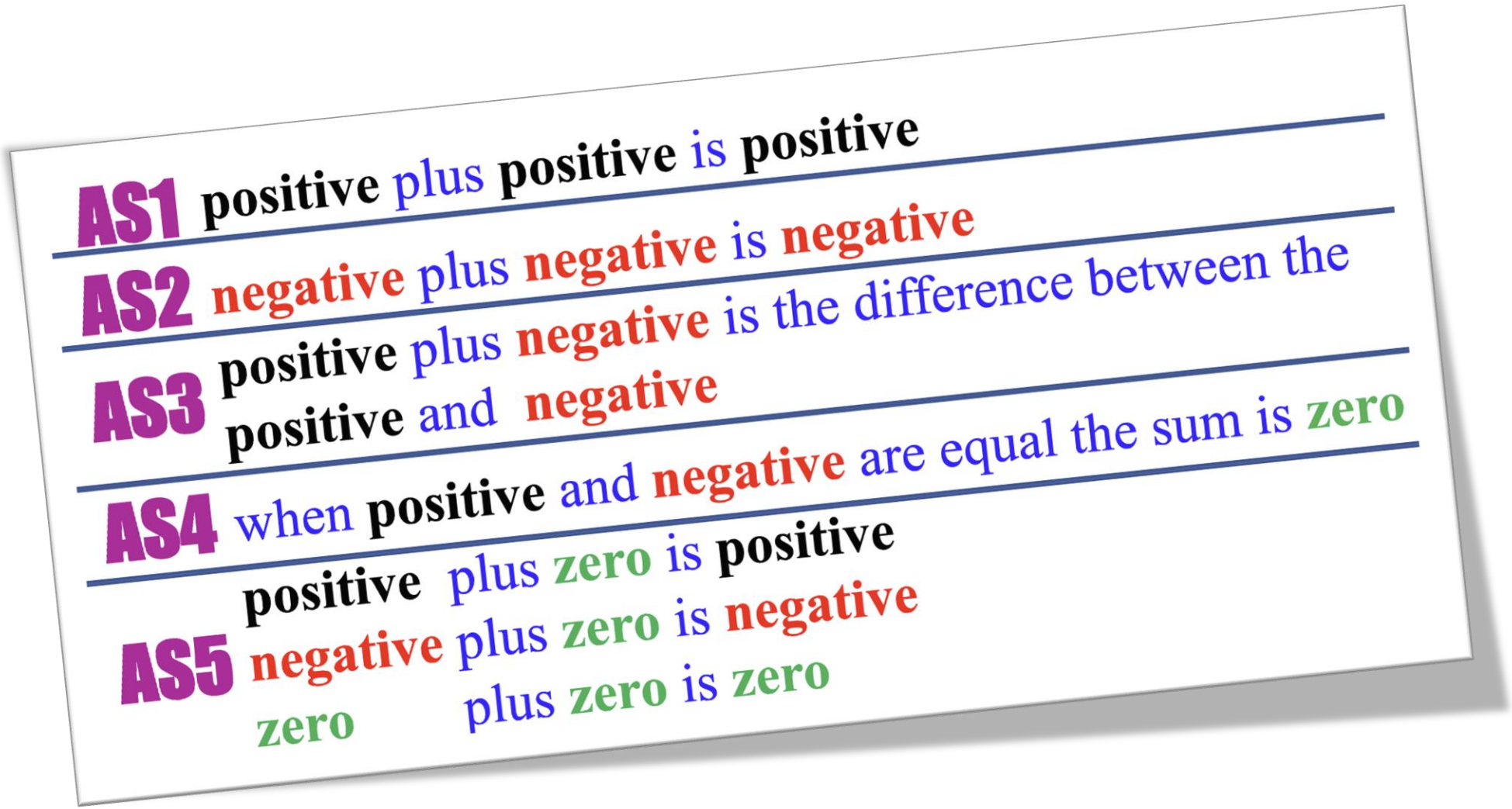
The Arabic world did not understand India’s Zero!

It was defined as a sum of equal and opposite quantities.

628

- **Brahmagupta**
- Brāhmasphuṭasiddhānta

THE BASIC ADDITION SUTRAS OF BRAHMAGUPTA



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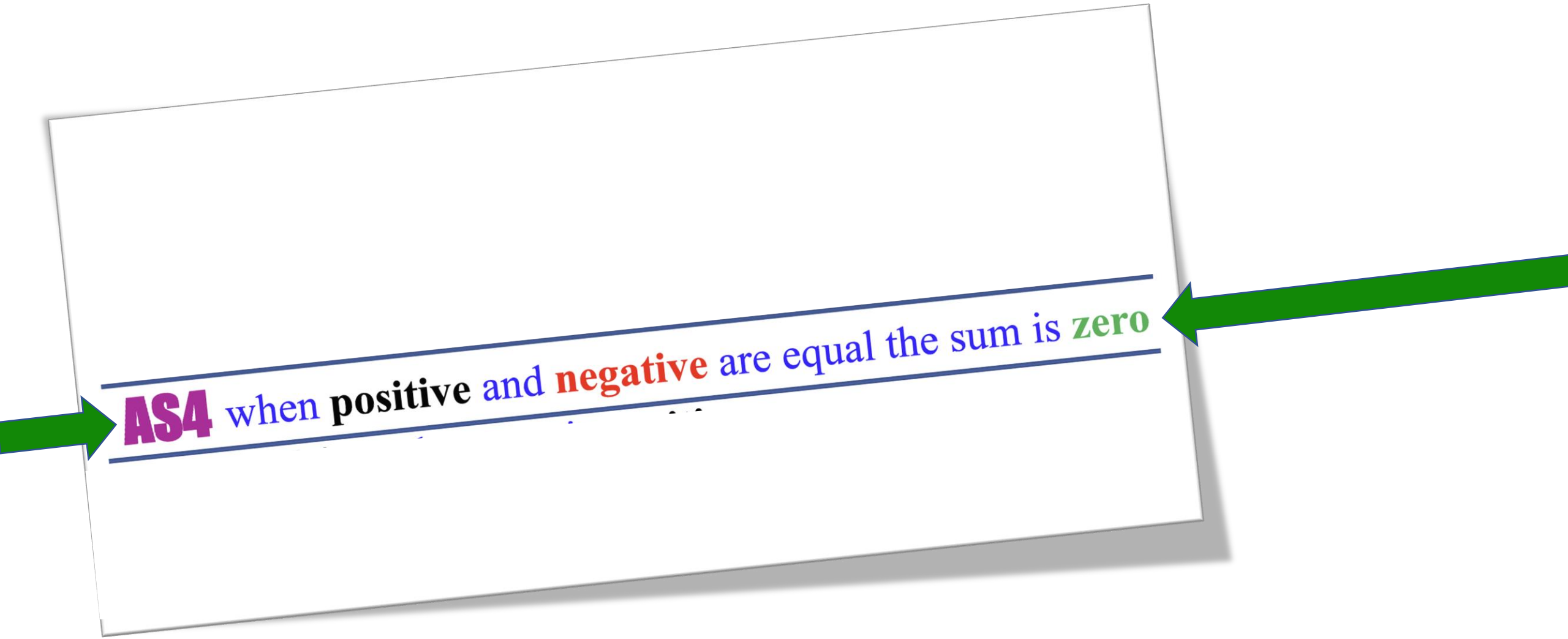
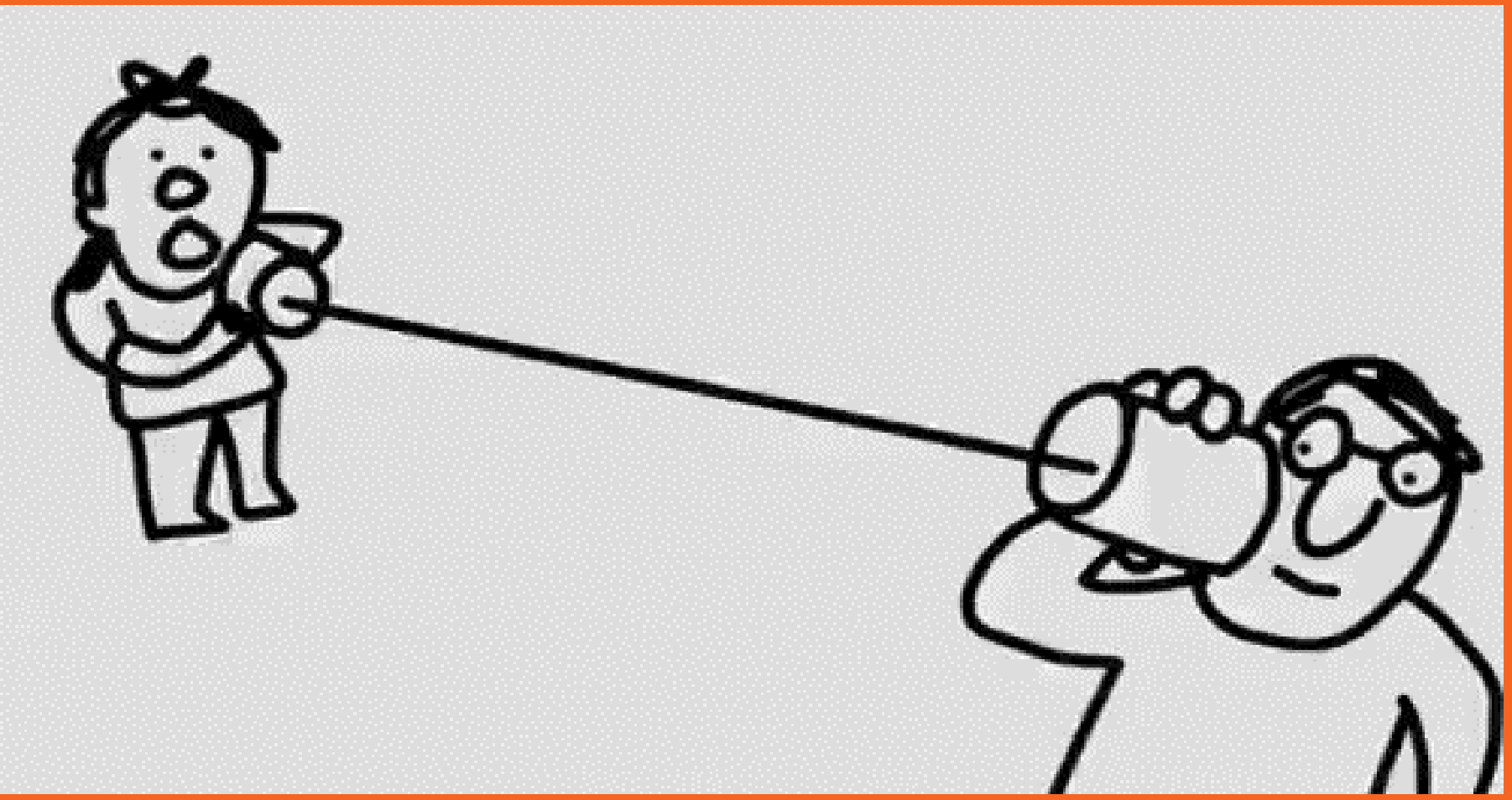


NONE OF THESE ARABIC AUTHORS ON INDIAN MATHS UNDERSTOOD INDIA'S LAWS OF ZERO

Al-Khwārazmī
Al-Nīsābūrī
Al-Uqlīdisī
Kūshyār ibn Labbān
Al-Baghdādī
Al-Ṣardafī
Al-Samaw'al
Ibn al Yāsamīn
Al-Ḥaṣṣār
Ibn Mun'im
Naṣīr al-Dīn al-Tusī
Al-Abharī
Ibn al-Bannā
Al-Hawārī
Al-Mawāḥidī
Ibn al-Qunfūdh
Ibn al-Hā'im
Al-Kāshī
Ibn al-Majdī
Al-Qalaṣādi
Raḍī al-Dīn ibn al-Ḥanbalī
Al-Ghazzī
Taqī al-Dīn
Yaḥyā al-Ru'aynī
Al-Sakhāwī
Al-Qabāqibī
Al-'Āmilī
Nūr al-Dīn al-Anṣārī
Ḥusayn al-Maḥallī
and others

From 'Zero and nothing in medieval
Arabic arithmetic' by Jeffrey Oaks

LIKE THE GAME BROKEN TELEPHONE, INDIA'S SYMMETRIC ZERO GOT LOST IN TRANSMISSION



In 1522, I never knew India's ZERO was a sum of equal and opposite quantities!

Transmission of zero as a placeholder, yet not as defined by Brahmagupta 628 CE.

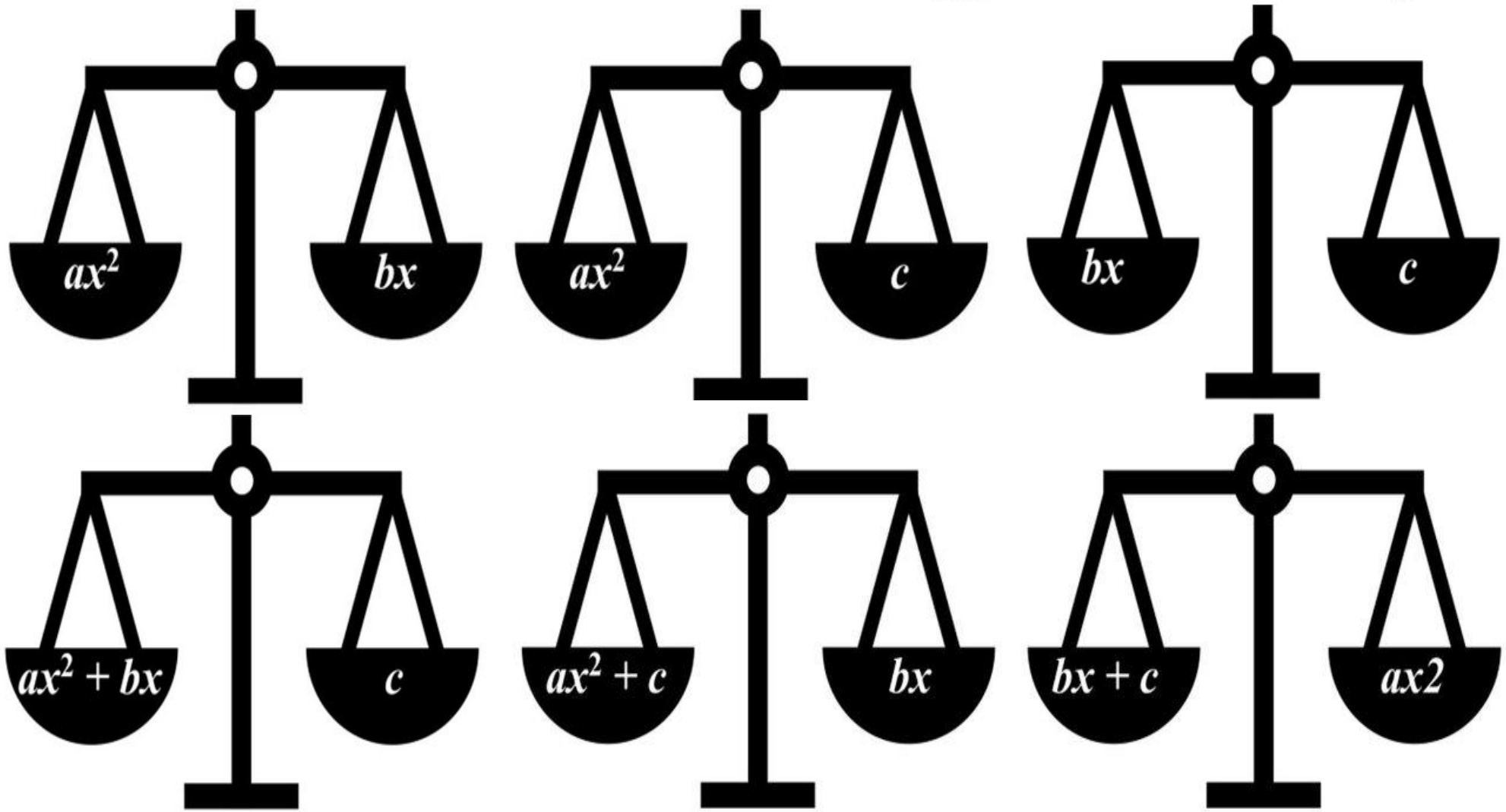
Those unaware zero was defined as the sum of equal pos. & neg.

- Al-Khwārizmī, Iraq 9th C.
- Traders, Nth Africa 12th C.
- Leonardo Pisano, Italy 13th C.
- Cuthbert Tunstall, England 16th C.

NO ZERO OR NEGATIVES IN ARABIC ALGEBRA

Never $ax^2 + bx + c = 0$ or $ax^2 - bx = {}^{-}c$

Al-Khwārizmī's six types of balanced equations

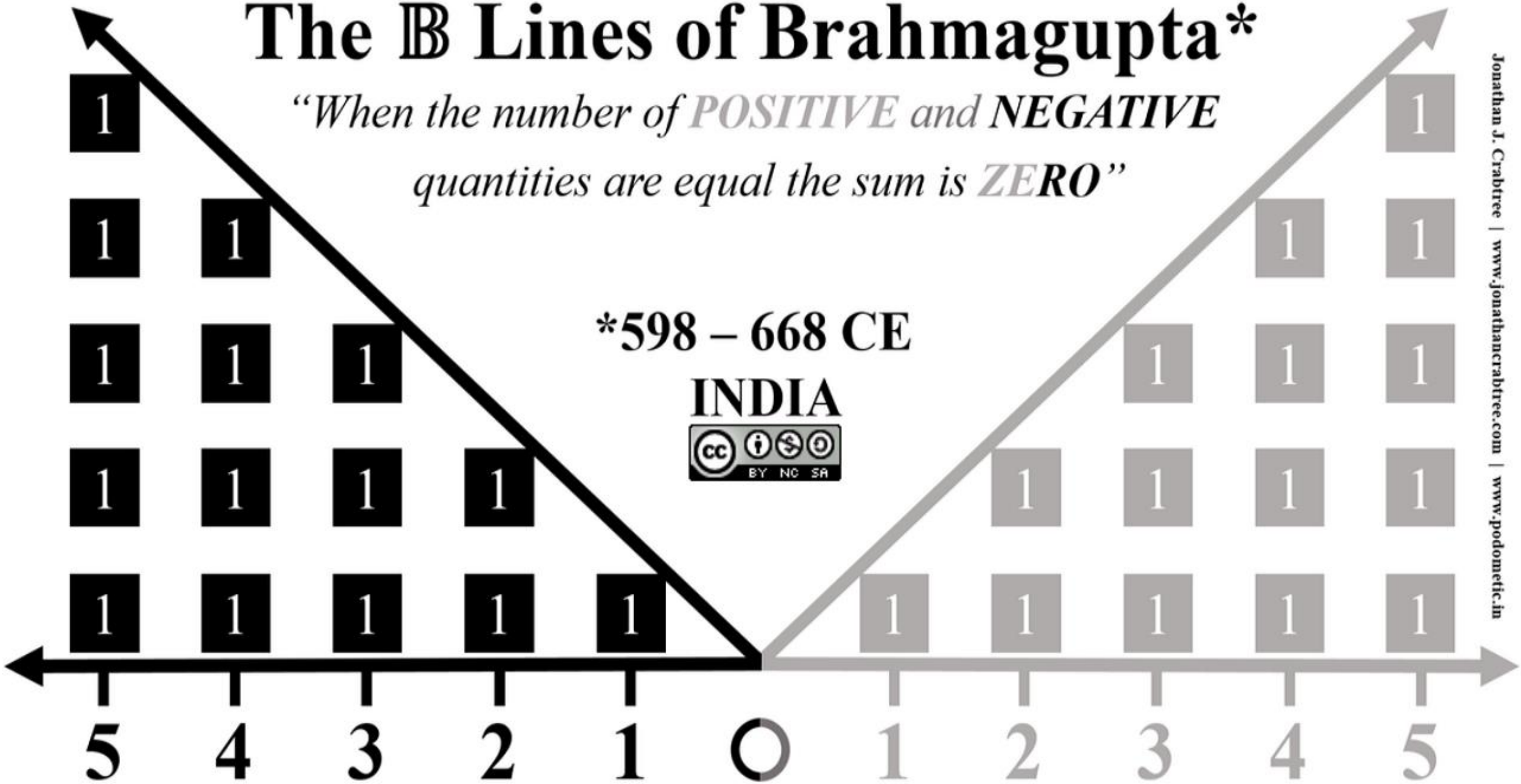


The 𝔹 Lines of Brahmagupta*

"When the number of POSITIVE and NEGATIVE quantities are equal the sum is ZERO"

***598 – 668 CE**

INDIA



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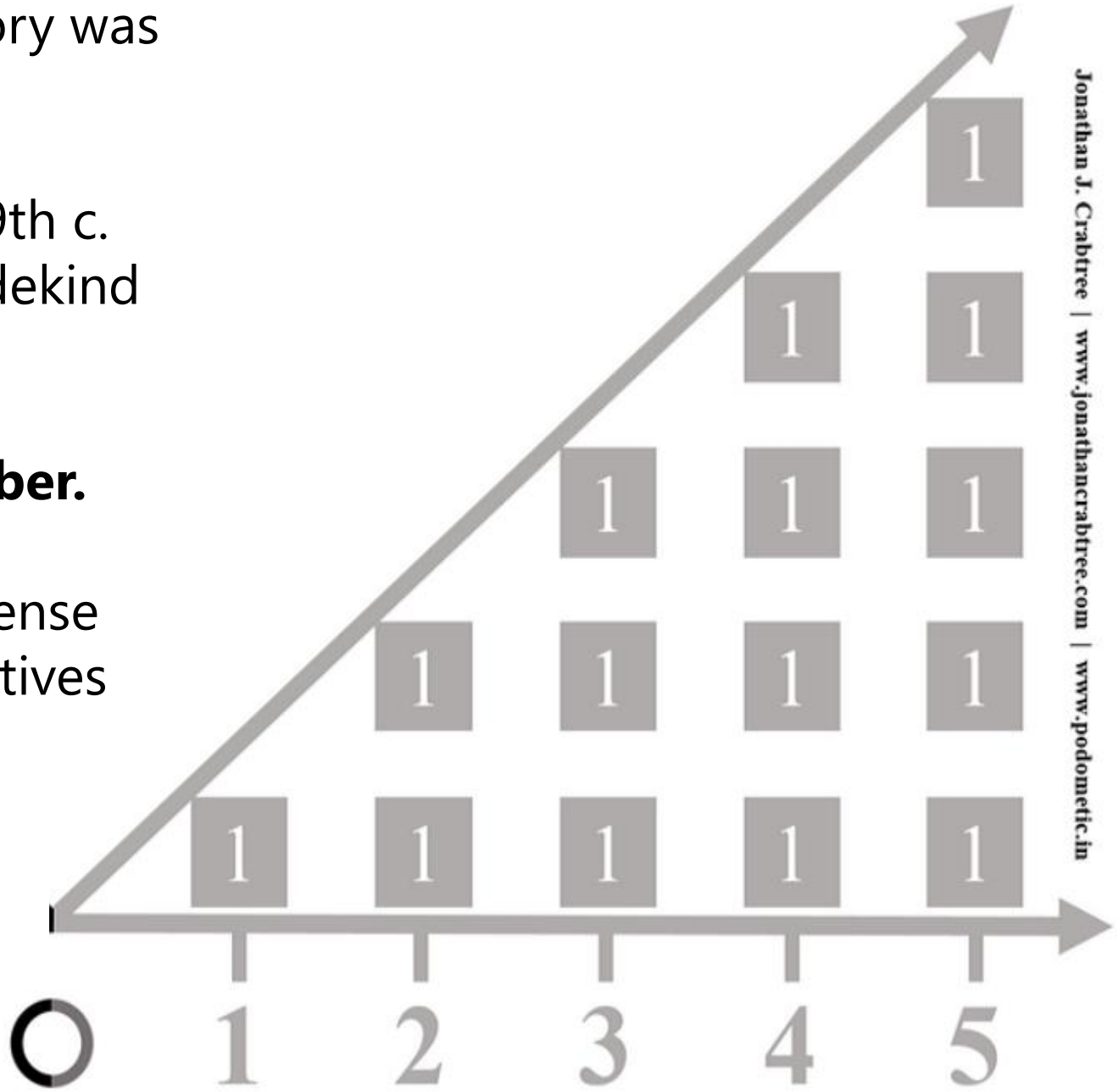
The entire body of western number theory was built upon HALF the set of Integers.

AXIOMS for ARITHMETIC arose in the 19th c. for NUMBER THEORY via Grassman, Dedekind & Peano.

E.g. 1 is not the successor of any number.

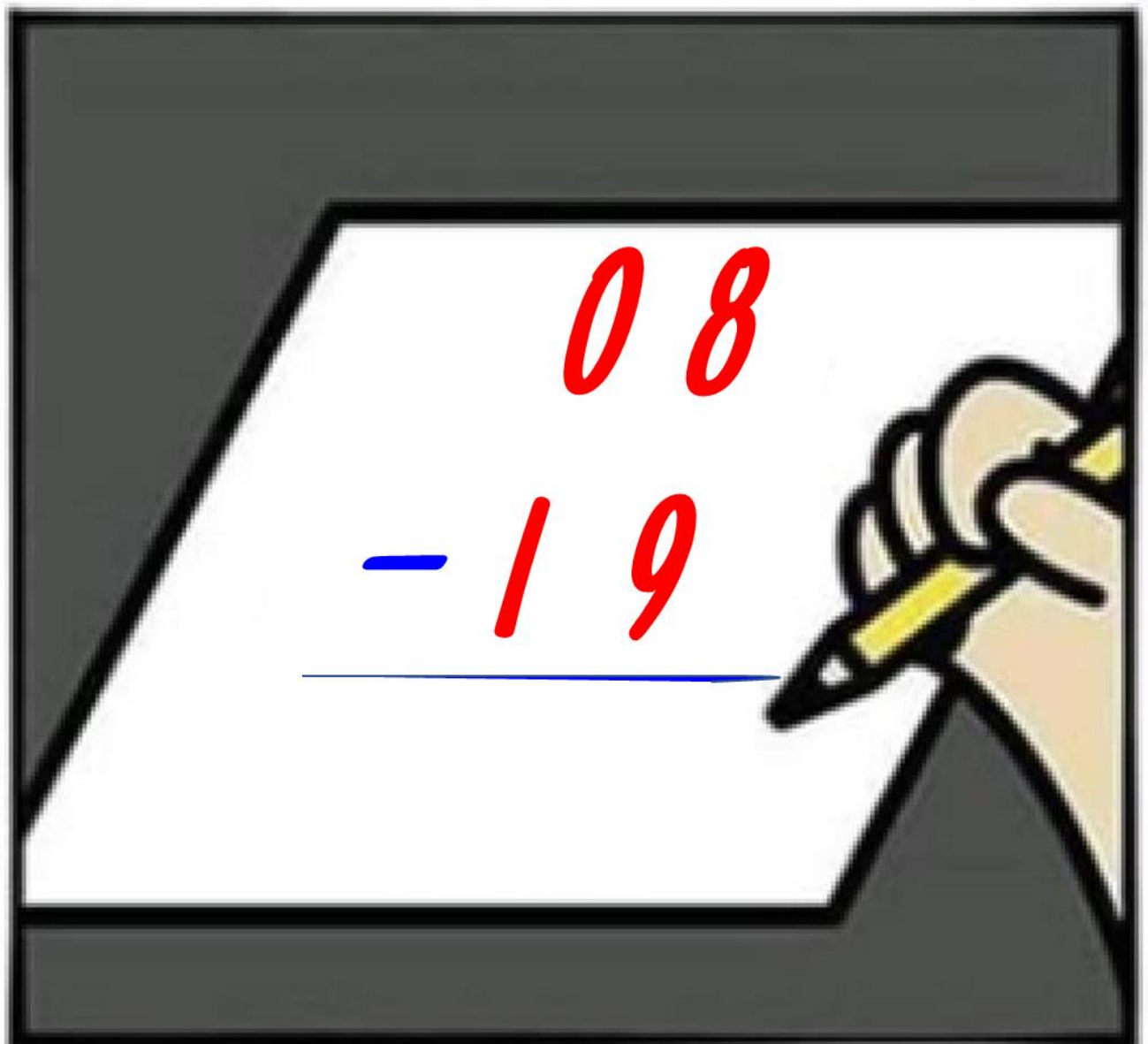
Thus, number theory supports the nonsense notion 5 negatives are LESS than 2 negatives

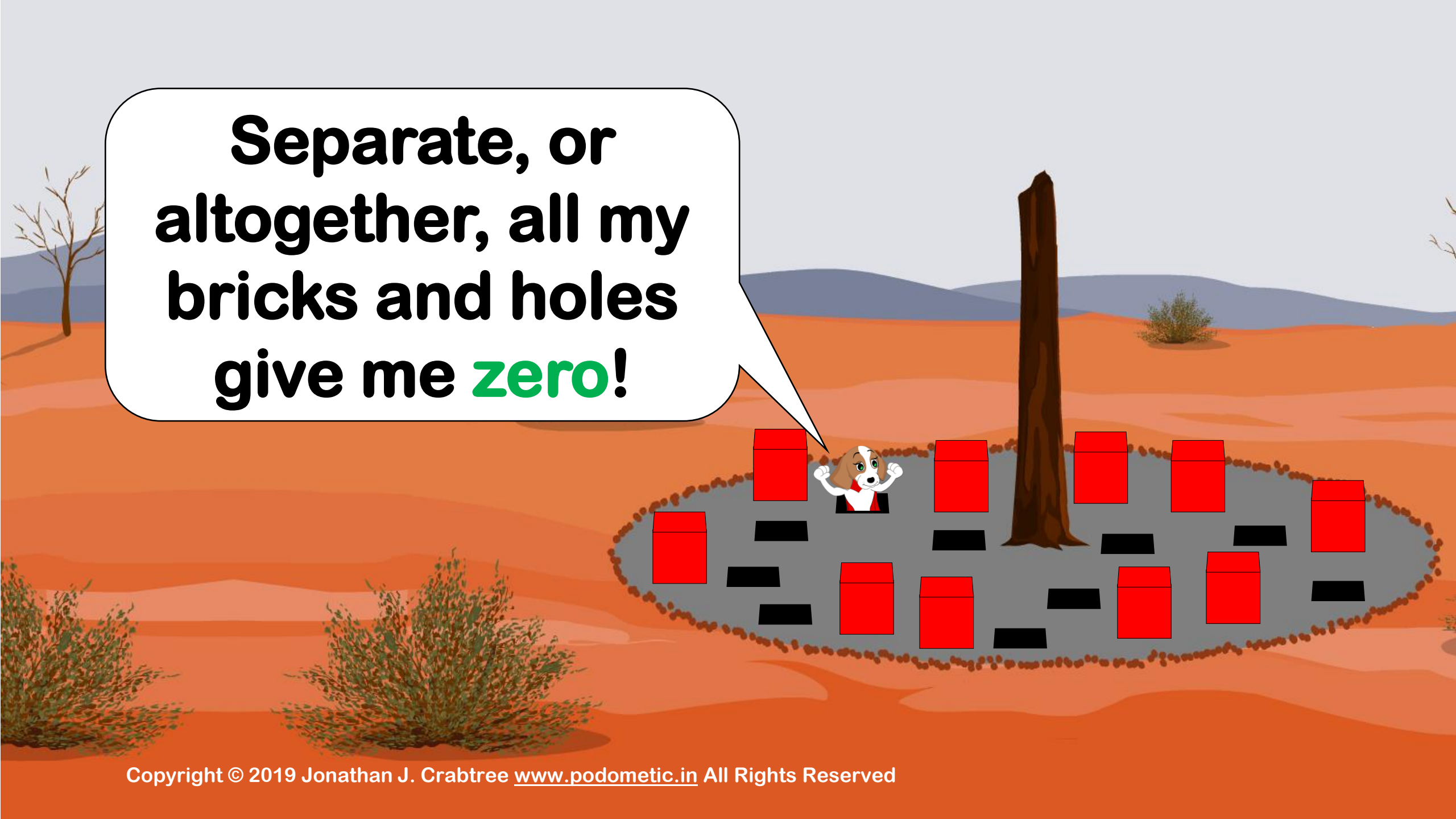


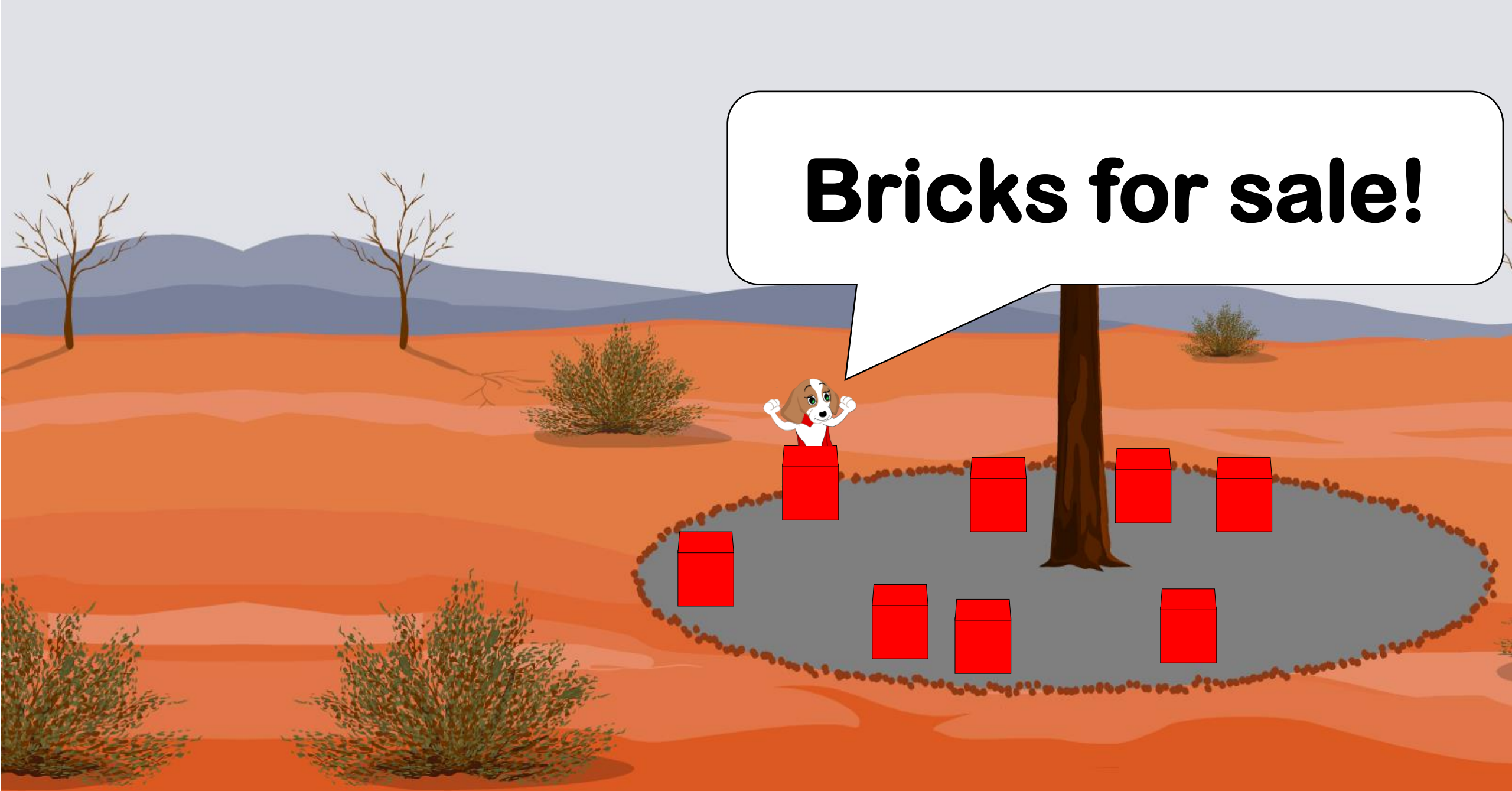
Let’s connect the dots behind broken British maths pedagogies of 2022

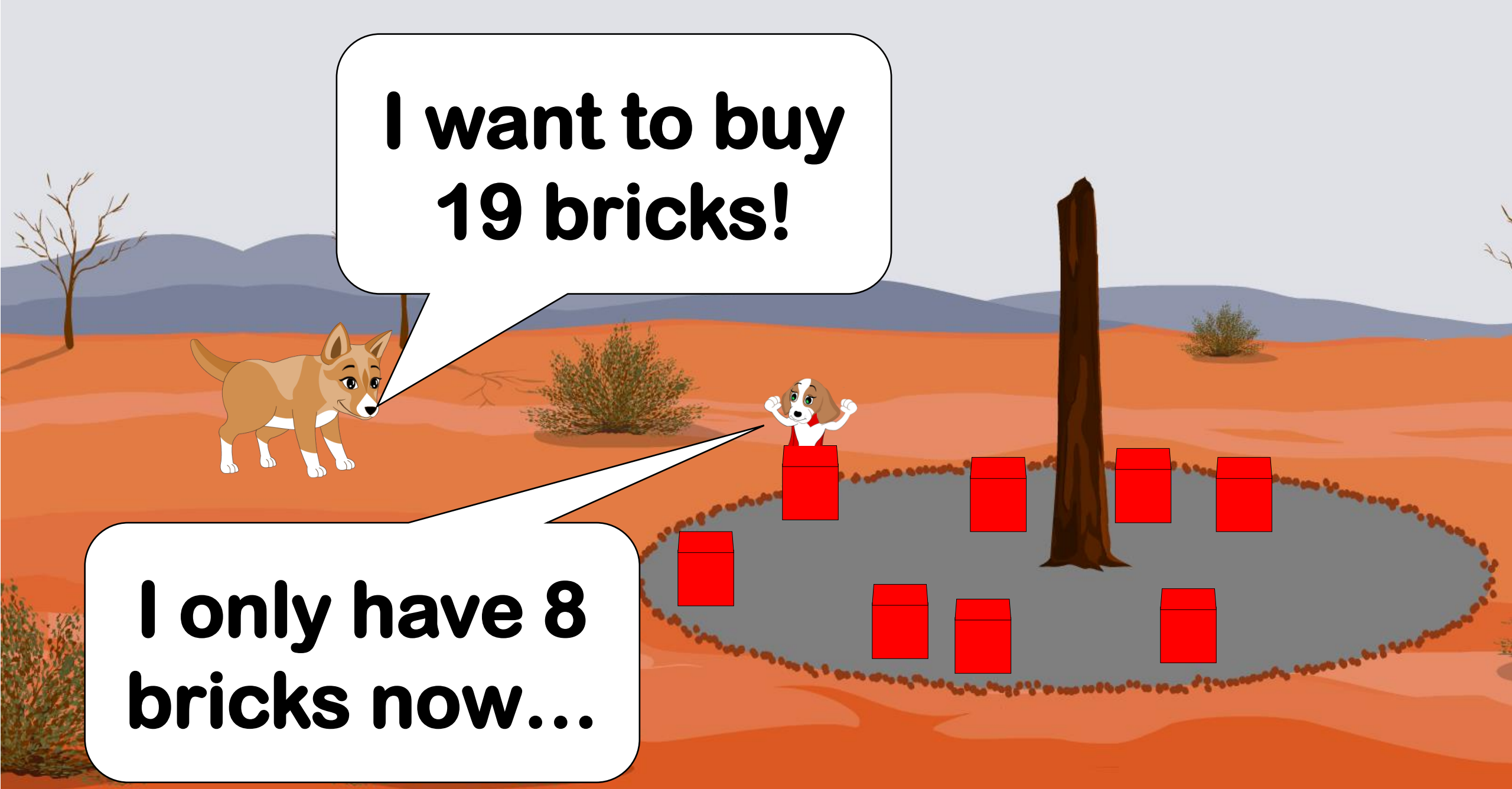
- **Al-Khwarizmi misunderstood India's maths of zero negatives and positives. So...**
- **Leonardo Pisano** misunderstood India's maths of zero negatives and positives. So...
- **Piero della Francesca** misunderstood India's maths of zero negatives and positives. So...
- **Luca Pacioli** misunderstood India's maths of zero negatives and positives. So...
- **Cuthbert Tunstall** misunderstood India's maths of zero negatives and positives. **So in 2022...**

BASIC ALGORITHMIC PROCEDURES FOR CLASS 2 SUBTRACTION ARE MISSING!









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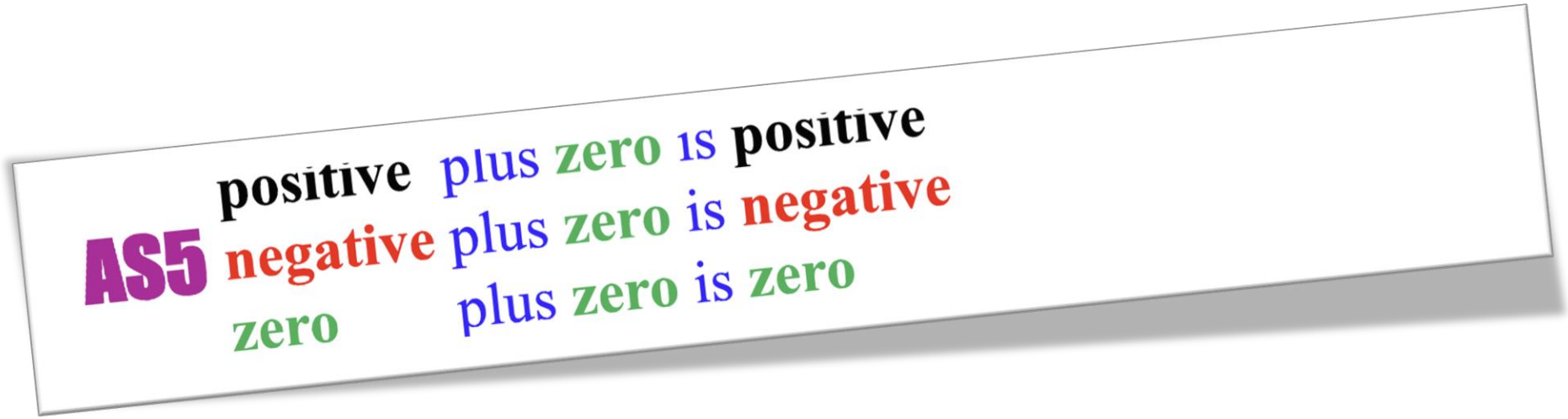

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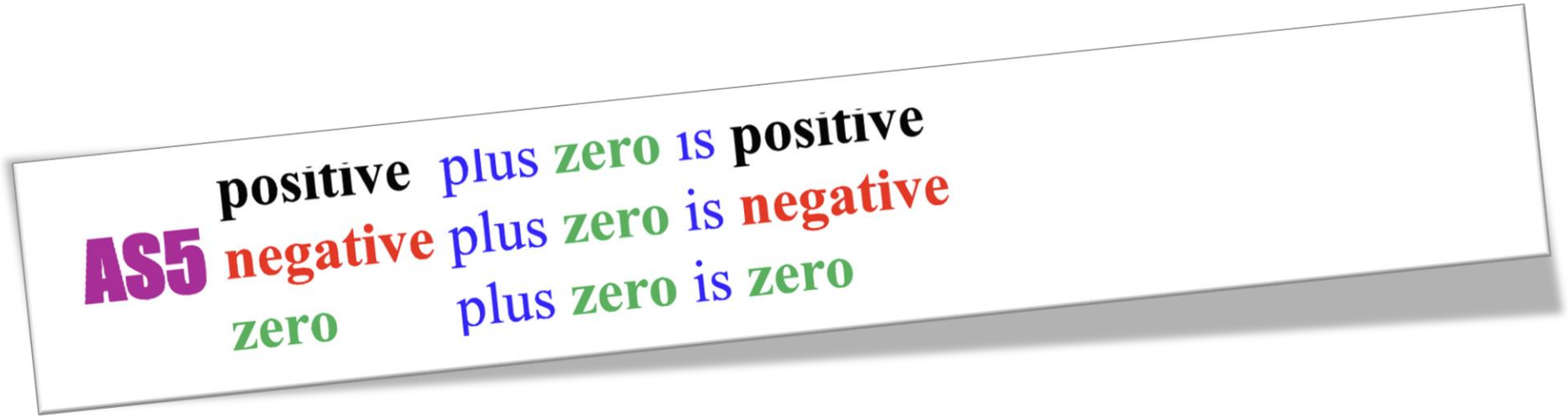
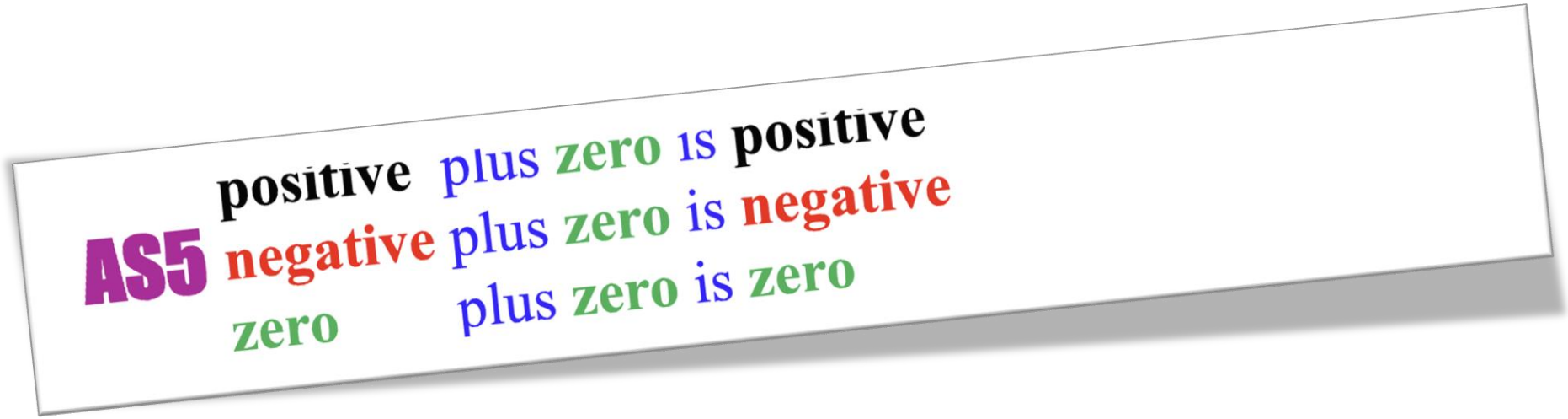


$$^{+}8 - {}^{+}19$$

BASIC ALGORITHMIC PROCEDURES FOR CLASS 2 SUBTRACTION ARE MISSING!



$$^{-}11 + {}^{+}11 + {}^{+}8 - {}^{+}19$$

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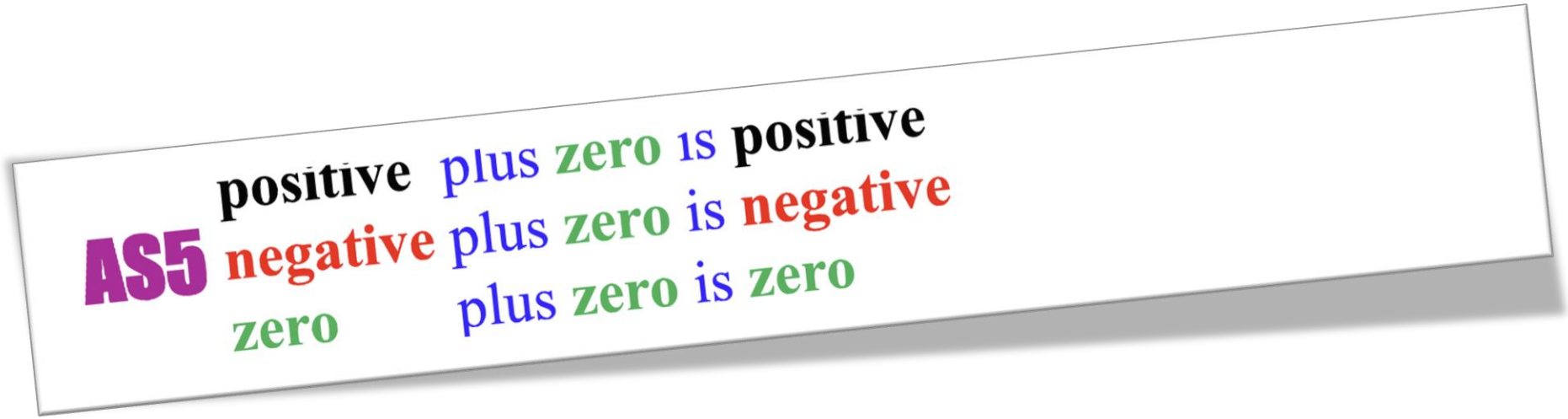


$$^{-}11 + {}^{+}11 + {}^{+}8 - {}^{+}19$$

$$^{-}11$$

BASIC ALGORITHMIC PROCEDURES FOR CLASS 2 SUBTRACTION ARE MISSING!

SS1 A smaller **positive** subtracted from a larger **positive** is **positive**.

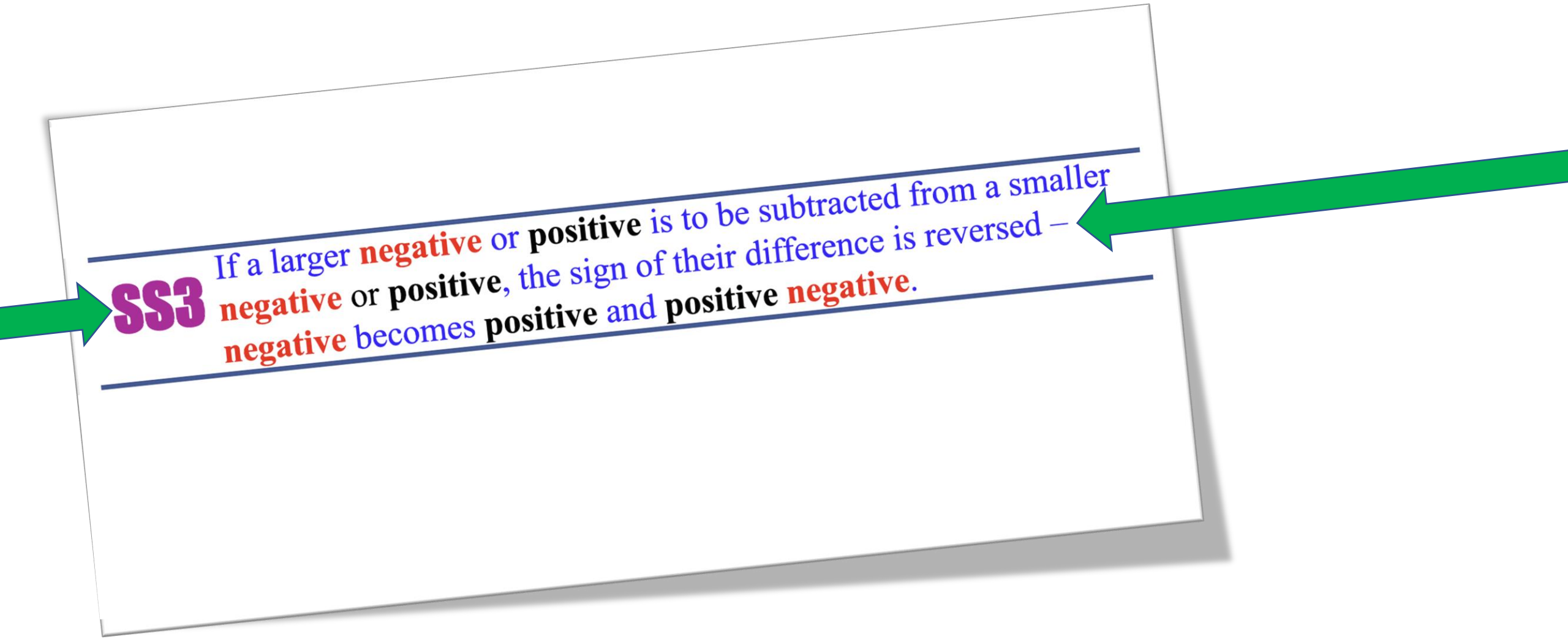
SS2 A smaller **negative** subtracted from a larger **negative** is **negative**.

SS3 If a larger **negative** or **positive** is to be subtracted from a smaller **negative** or **positive**, the sign of their difference is reversed – **negative** becomes **positive** and **positive** **negative**.

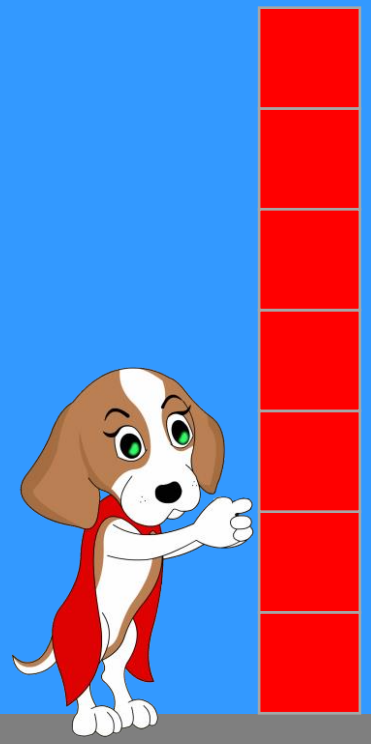
SS4 A **negative** minus **zero** is **negative**,
a **positive** minus **zero** is **positive**,
zero minus **zero** is **zero**.

SS5 When a **positive** is to be subtracted from a **negative** or a **negative** from a **positive**, then it is to be added.

BASIC ALGORITHMIC PROCEDURES FOR CLASS 2 SUBTRACTION ARE MISSING!



7 bricks minus 10 bricks



7 bricks minus 10 bricks leaves 3 holes remaining

When greater is taken away from lesser my things change!

3 holes

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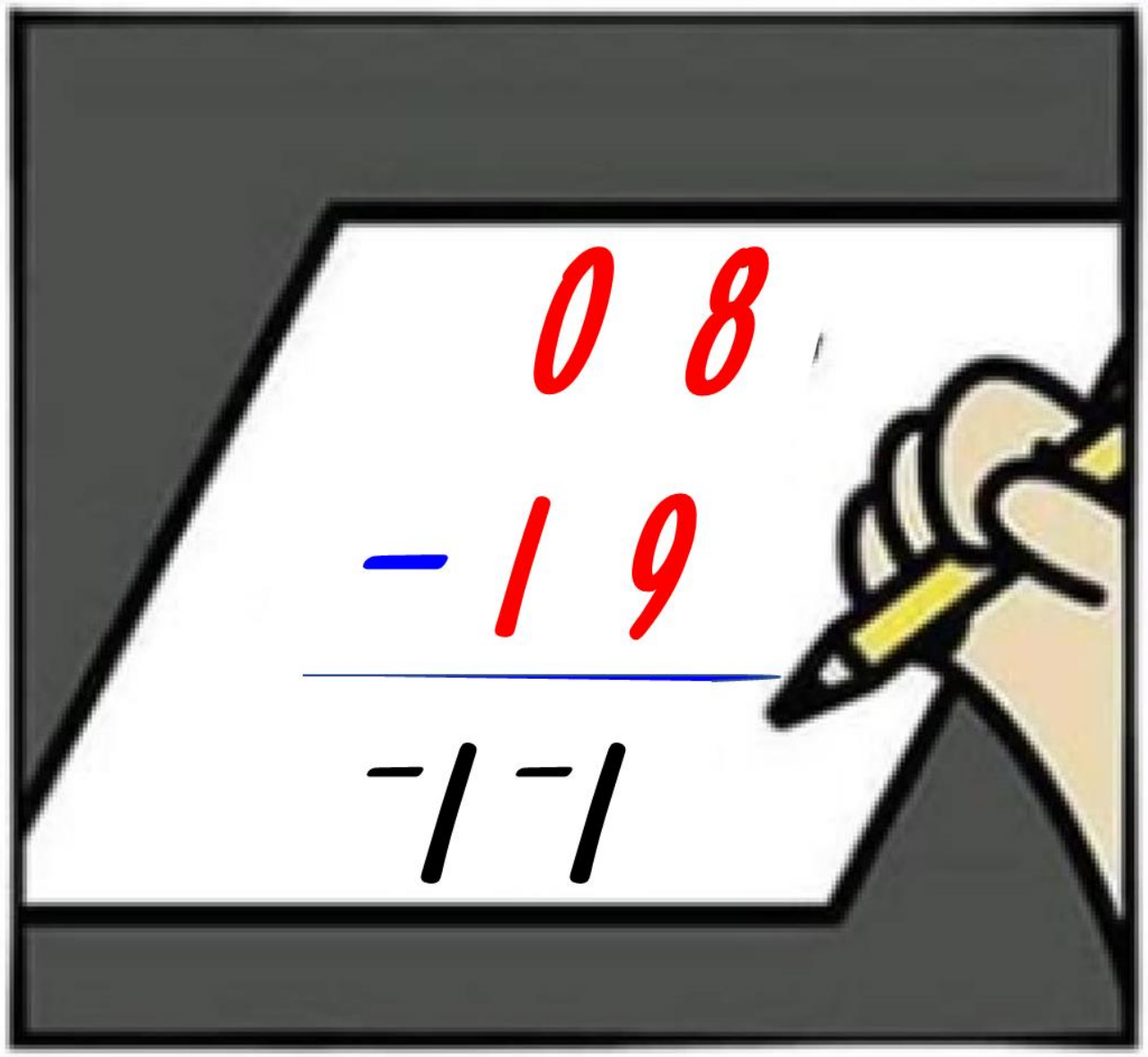

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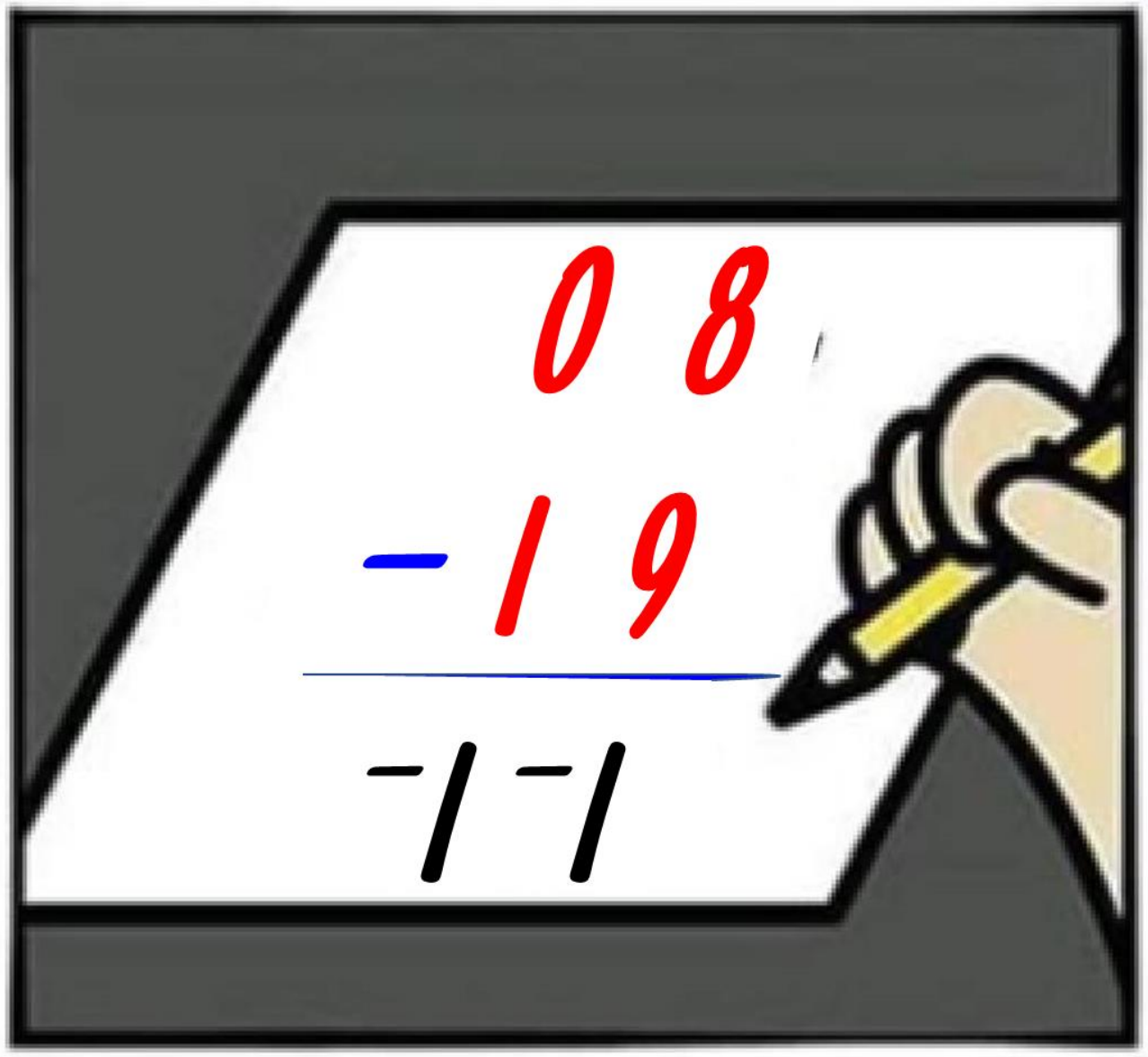


UNITS

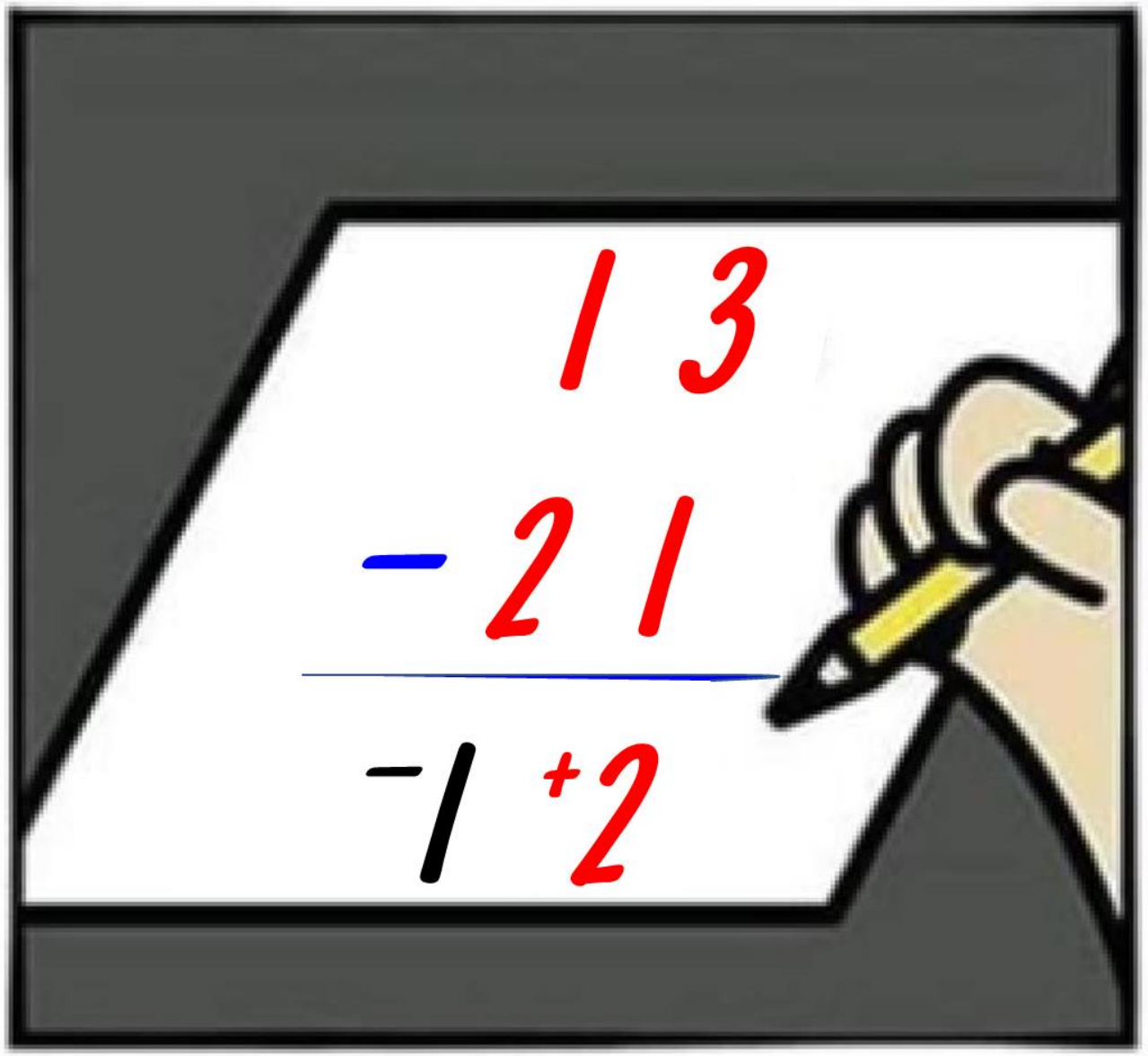
$$\begin{array}{r} {}^{+}8 \\ -\ {}^{+}9 \\ \hline {}^{-}1 \end{array}$$

TENS

$$\begin{array}{r} 0 \\ -\ {}^{+}1 \\ \hline {}^{-}1 \end{array}$$

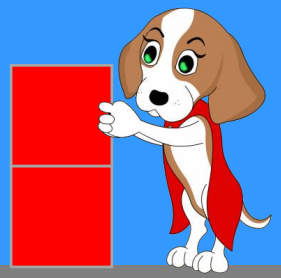
So, $^{+}8 - {}^{+}19 = {}^{-}11$

BASIC ALGORITHMIC PROCEDURES FOR CLASS 2 SUBTRACTION ARE MISSING!



Next step, combine
10 holes and 2 bricks

−1 +2



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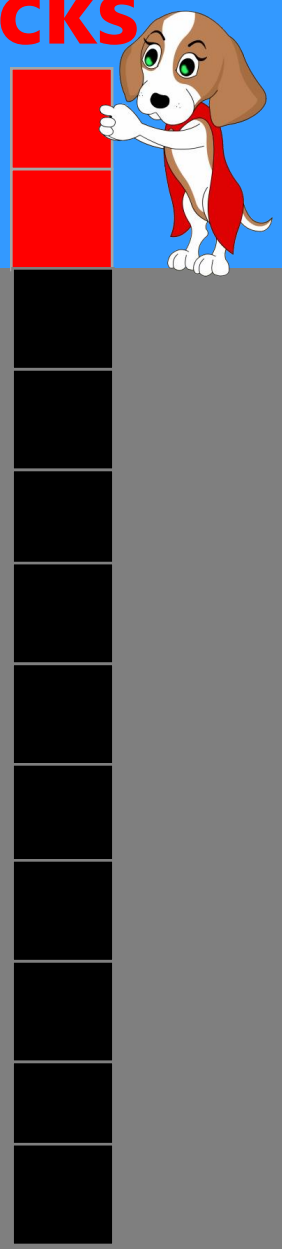

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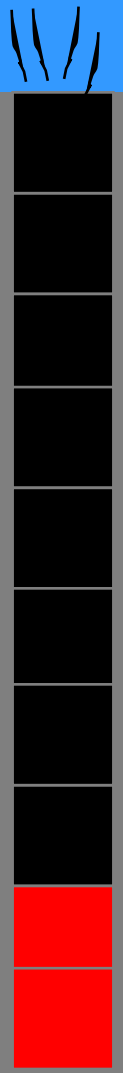
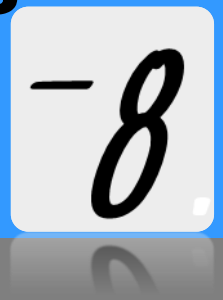
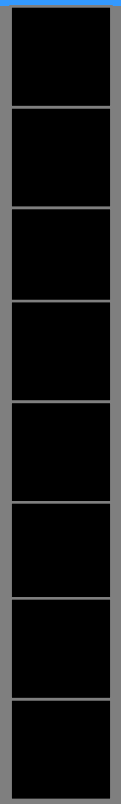


10 holes and 2 bricks make 8 holes





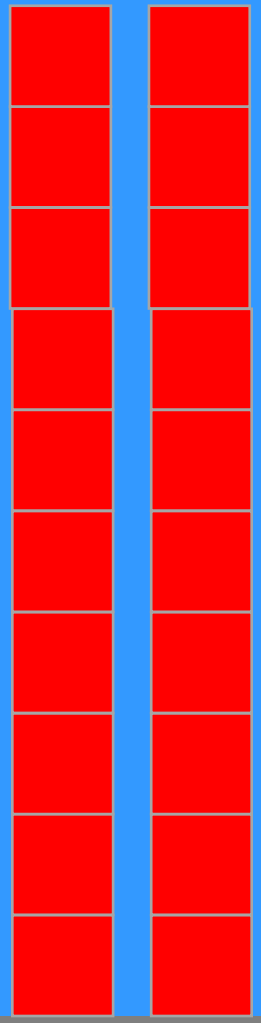
Diophantus

$$4x + 20 = 4$$

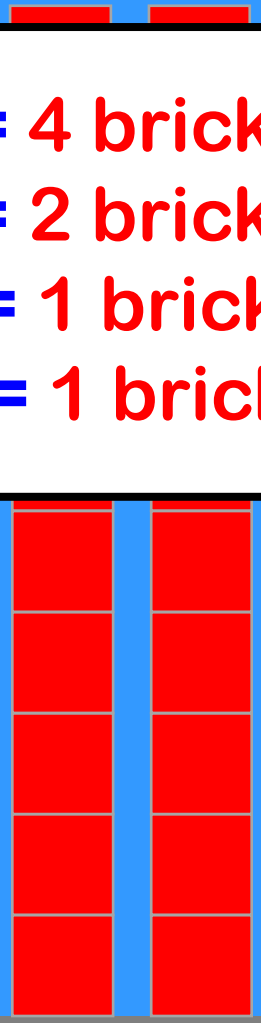
Diophantus

$4x + 20 = 4$

I need 4 same size things (4*x*) to make 16 bricks go away leaving 4 bricks. I need 4 holes!



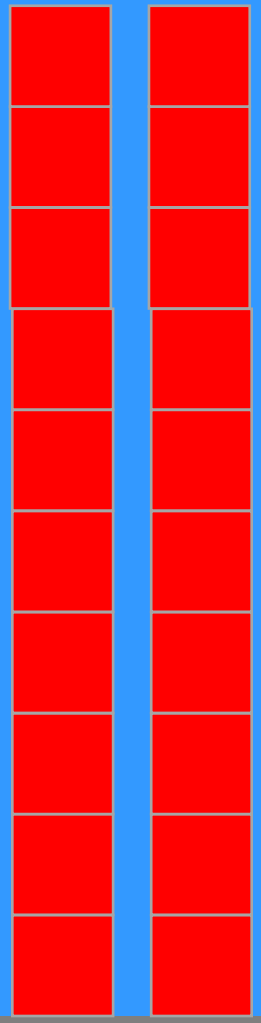
4 things + 20 bricks = 4 bricks
2 things + 10 bricks = 2 bricks
1 thing + 5 bricks = 1 brick
4 holes + 5 bricks = 1 brick



Diophantus

$$4x + 20 = 4$$

With 20 bricks I need 4 holes each 4 deep to make 16 bricks go away to leave 4 bricks.



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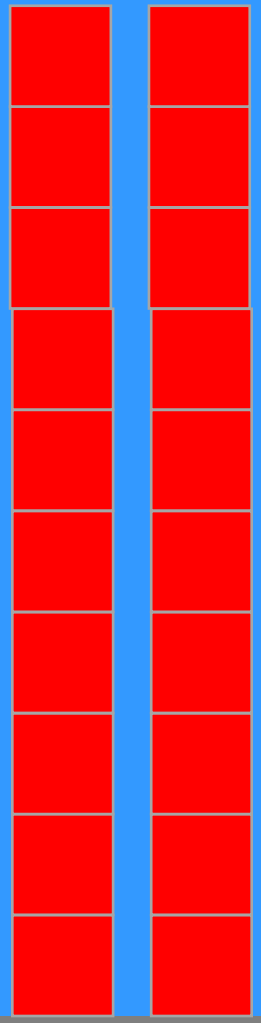
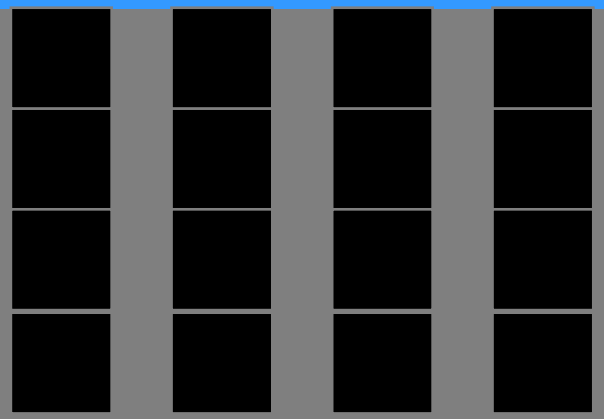
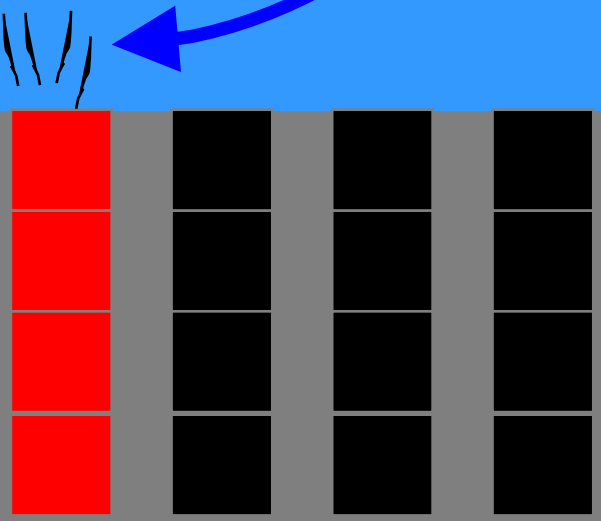
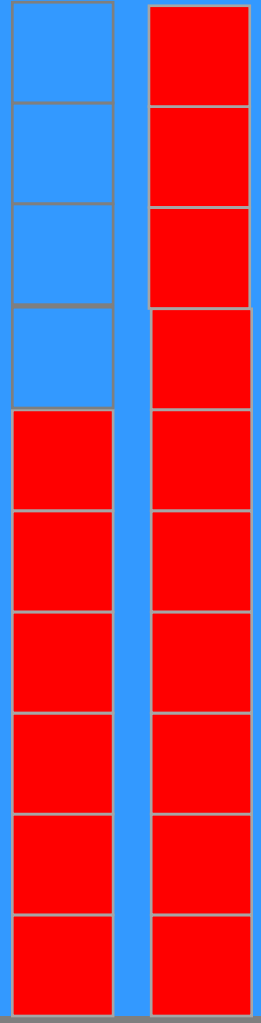




Diophantus

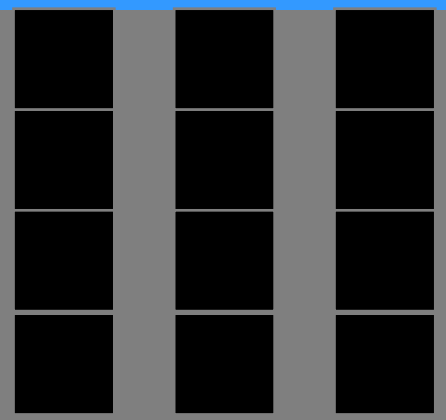
$4x + 20 = 4$

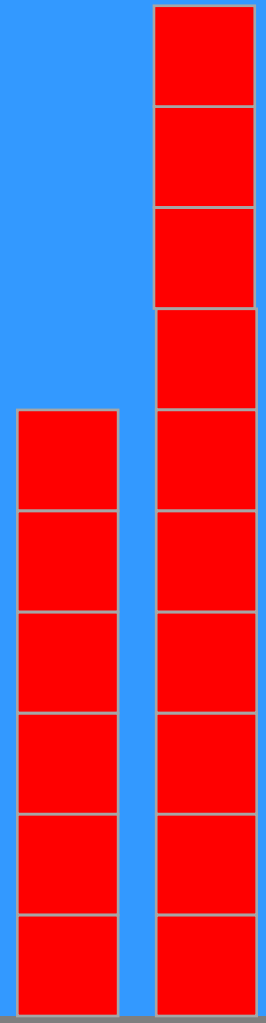




Diophantus

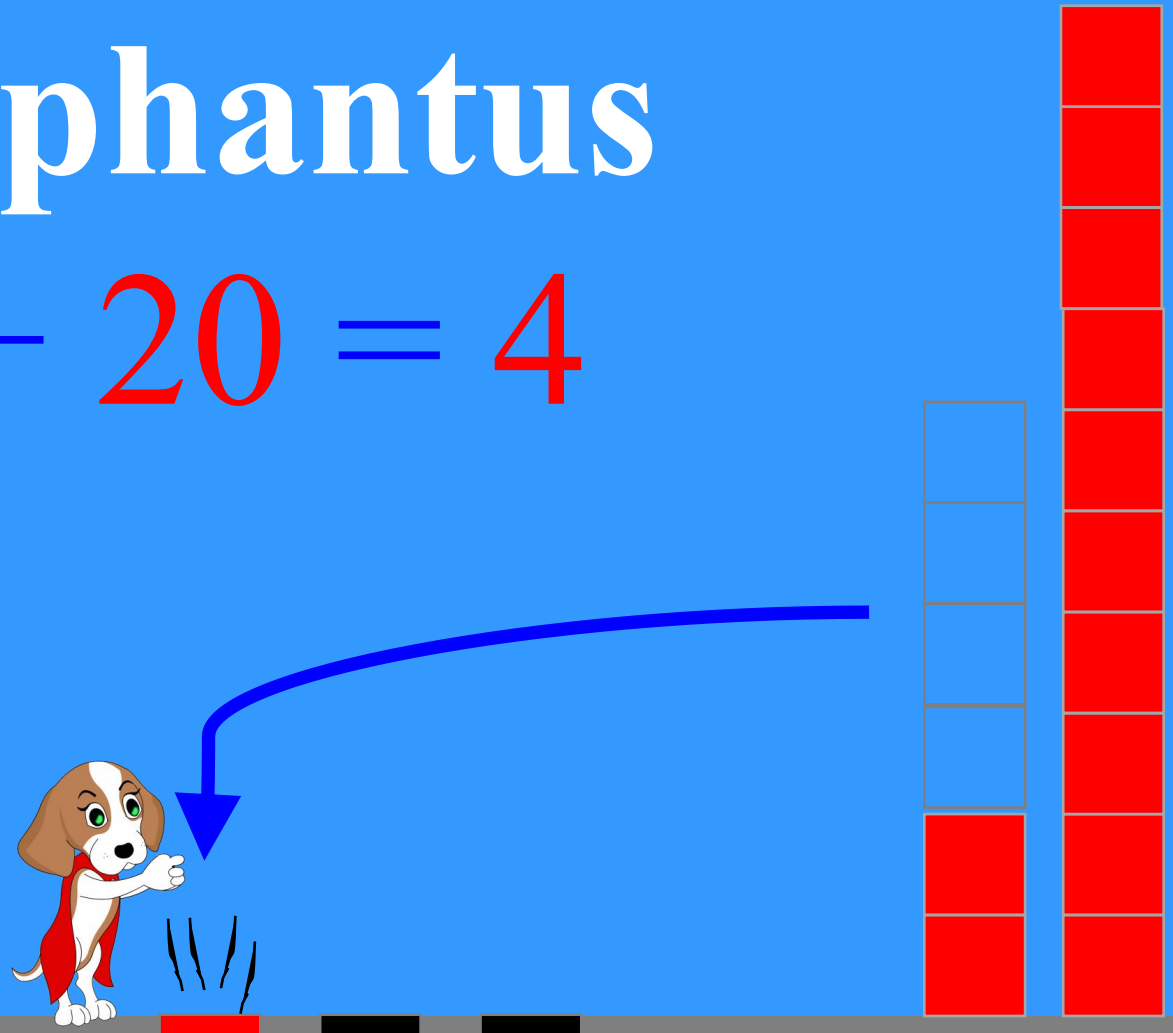
$4x + 20 = 4$





Diophantus

$$4x + 20 = 4$$

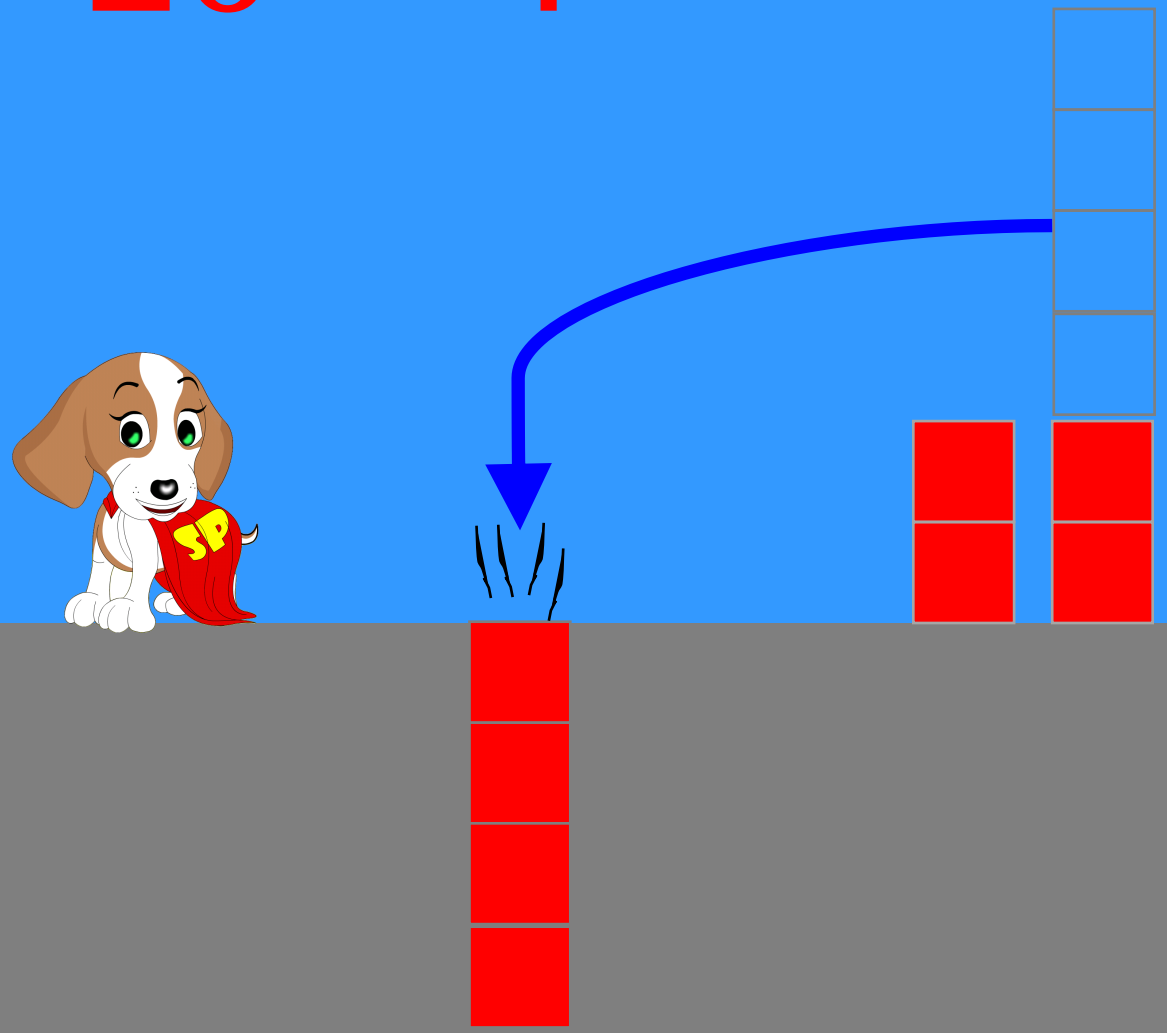


Diophantus

$4x + 20 = 4$

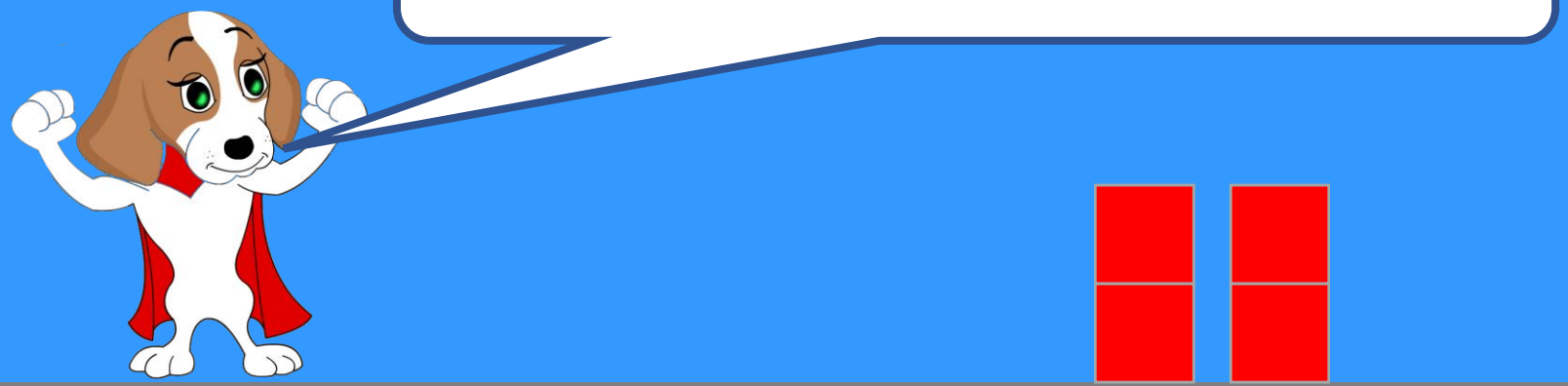
Diophantus

$$4x + 20 = 4$$



Diophantus

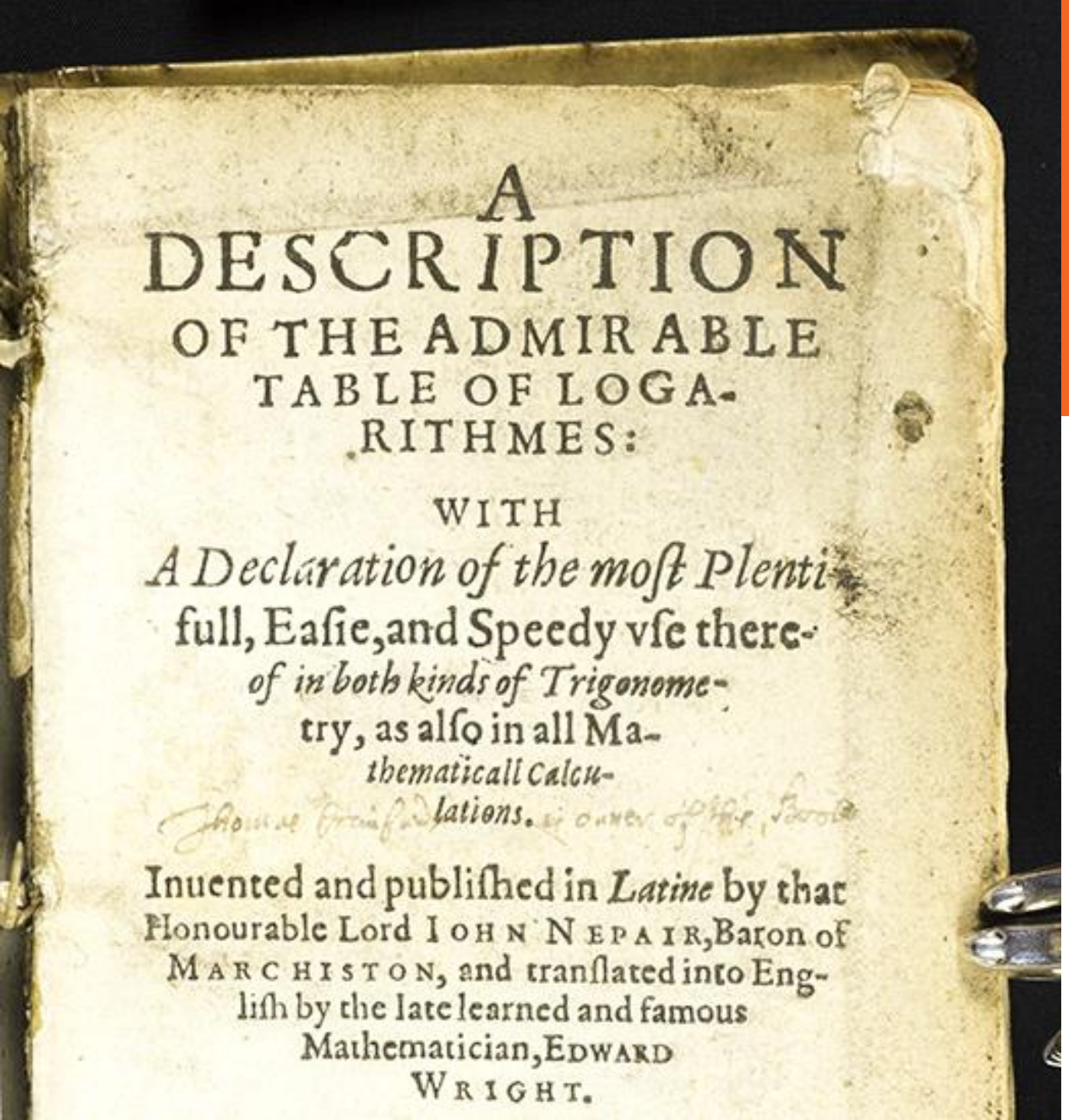
$$4x + 20 = 4$$



Diophantus

$$4x + 20 = 4$$

So, x must be
4 negatives
or $^{-}4$

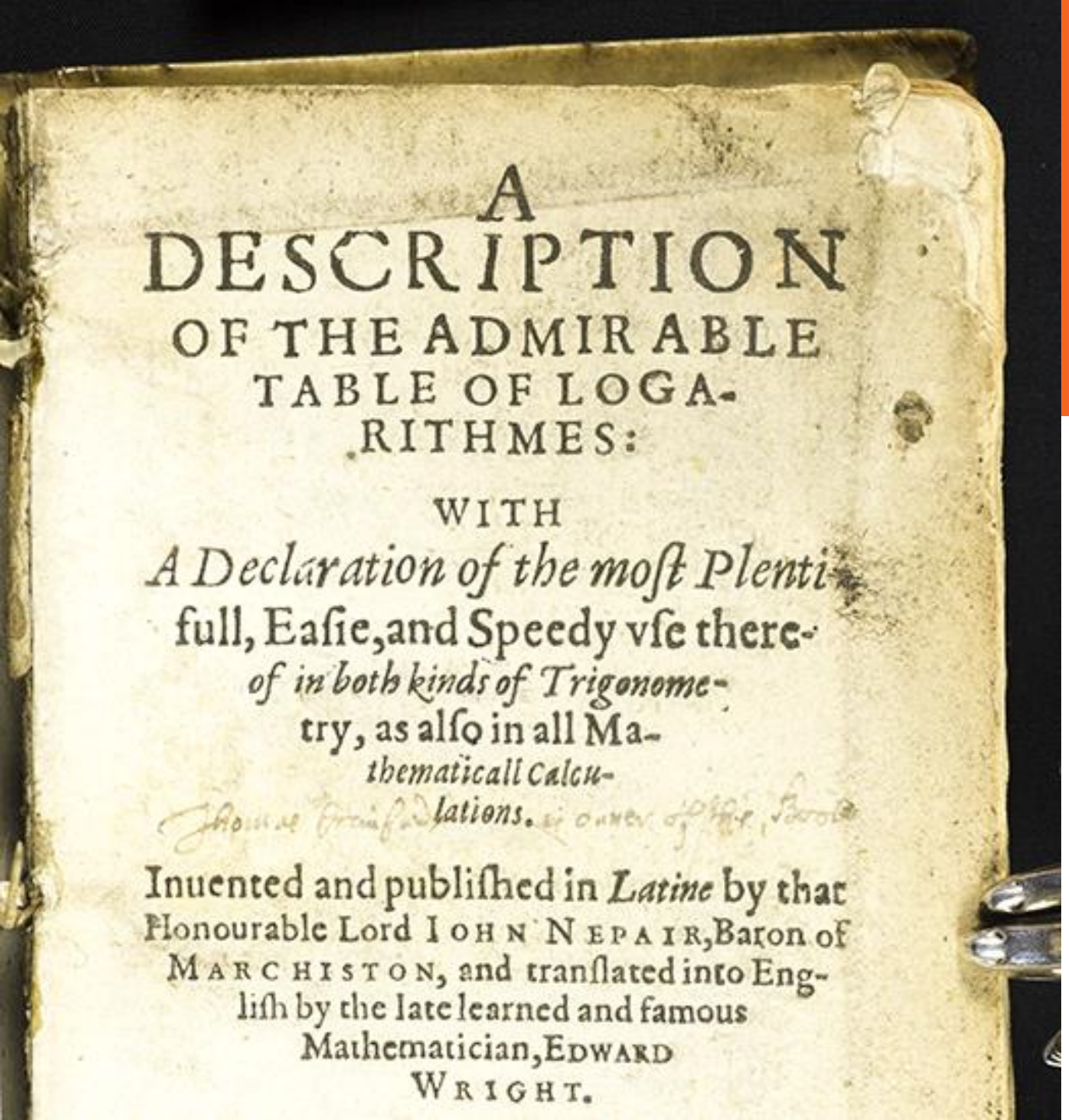

A
DESCRIPTION
OF THE ADMIRABLE
TABLE OF LOGA-
RITHMES:

WITH
A Declaration of the moſt Plenti-
full, Eaſie, and Speedy vſe there-
of in both kinds of Trigonome-
try, as alſo in all Ma-
thematicall Calcu-
lations.

Inuented and publiſhed in *Latine* by that
Honourable Lord IOHN NEPAIR, Baron of
MARCHISTON, and tranſlated into Eng-
liſh by the late learned and famous
Mathematician, EDWARD
WRIGHT.

Q. WHEN AND WHY DID NEGATIVE NUMBERS FIRST MAKE AN IMPACT IN ENGLAND?

A Description of the Admirable Table of Logarithmes (London, 1616)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WRIGHT.

A. JOHN NAPIER'S LOGARITHMS 1614 (LATIN) 1616 (ENGLISH)

But the Logarithmes which are ***lesse then nothing****, we cal Defectiue, or wanting, setting this marke - before them.*

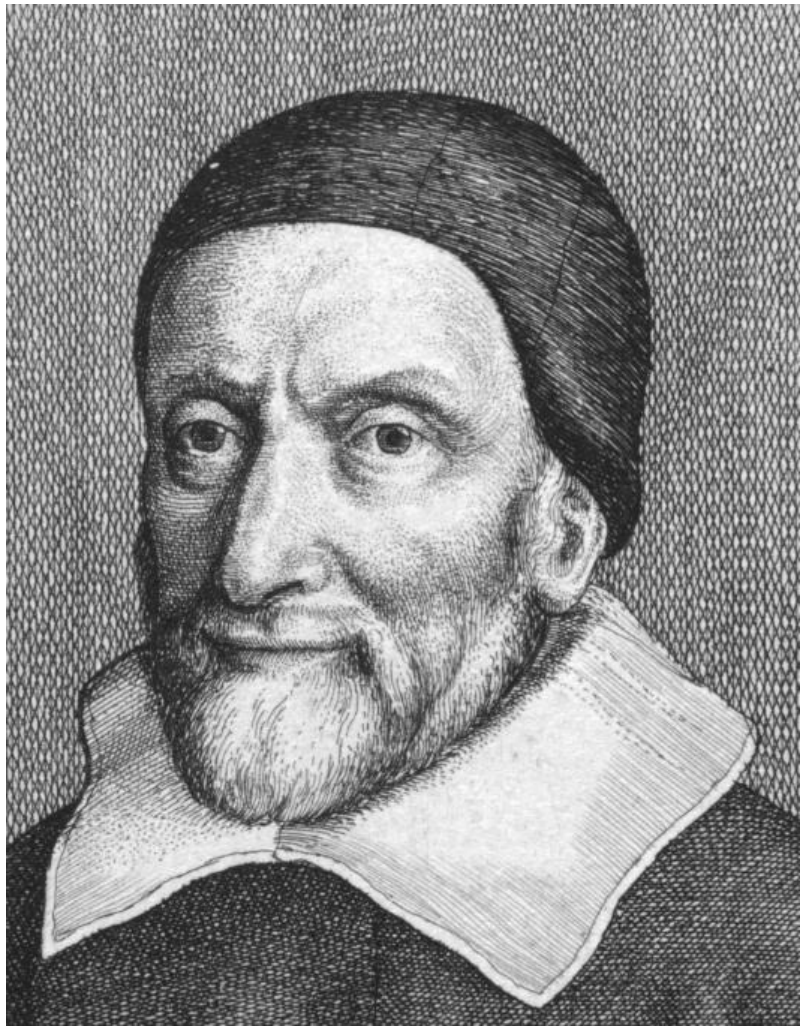
Exp. /Log	$^{+}4$	$^{+}3$	$^{+}2$	$^{+}1$	0	$^{-}1$	$^{-}2$	$^{-}3$	$^{-}4$
Number	10,000	1,000	100	10	1	0.1	0.01	0.001	0.0001

The base ten exponent is an absolute value count of the number of times the Unit 1 shifts Left ×10 ← or → Right ÷10

WILLIAM OUGHTRED 1631

And it is to be noted, that a negative Number, how great ſoever, is leſs than every both affirmative, and leſſer negative.
As —4 is leſs than 1, and than —1.
Alſo 'tis to be noted, that Subduction changeth the Sign of the Number to be ſubducted: As out of 4 take 6, there remains 4—6; that is, —2. And out of —4 take —6, their remains —4+6, that is 2. Laſtly, out of 4 take —6, their remains 4+6, that is 10. Wherefore in the extraction of the firſt ſingle Side, ſome tryals muſt be made until you find out the true ſide; which you ſhall certainly know by the next grea-

- One of the first major influencers to say negative numbers were less than zero

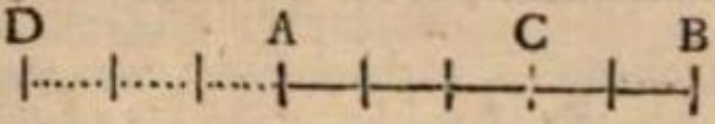


JOHN WALLIS 1685

CHAP. LXVI. *Of Negative Squares.*

Yet is not that Suppoſition (of Negative Quantities,) either Unuſeful or Abſurd; when rightly underſtood. And though, as to the bare Algebraick Notation, it import a Quantity leſs than nothing: Yet, when it comes to a Phyſical Application, it denotes as Real a Quantity as if the Sign were +; but to be interpreted in a contrary ſenſe.

As for inſtance: Suppoſing a man to have advanced or moved forward, (from A to B,) 5 Yards; and then to retreat (from B to C) 2 Yards: If it be asked, how much he had Advanced (upon the whole march) when at C? or how many Yards he is now Forwarder than when he was at A? I find (by Subducting 2 from 5,) that he is Advanced 3 Yards. (Becauſe $+5-2=+3$.)



But if, having Advanced 5 Yards to B, he thence Retreat 8 Yards to D; and it be then asked, How much he is Advanced when at D, or how much Forwarder than when he was at A: I ſay -3 Yards. (Becauſe $+5-8=-3$.) That is to ſay, he is advanced 3 Yards leſs than nothing.

- Negative quantities… import a Quantity less than nothing

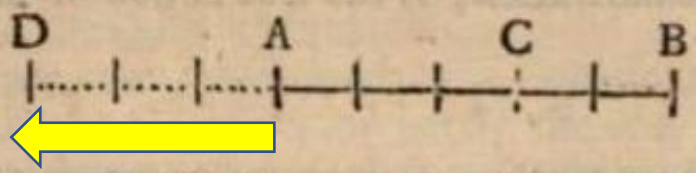
JOHN WALLIS 1685

CHAP. LXVI. *Of Negative Squares.*

Yet is not that Suppoſition (of Negative Quantities,) either Unuſeful or Abſurd; when rightly underſtood. And though, as to the bare Algebraick Notation, it import a Quantity leſs than nothing: Yet, when it comes to a Phyſical Application, it denotes as Real a Quantity as if the Sign were +; but to be interpreted in a contrary ſenſe.

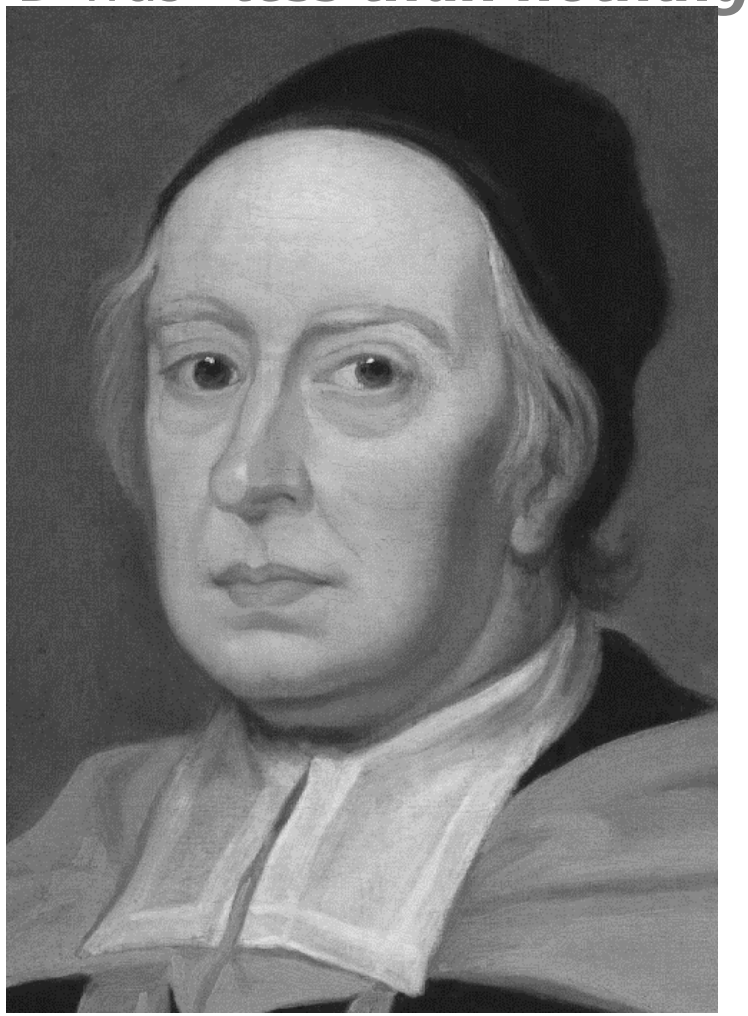
As for inſtance: Suppoſing a man to have advanced or moved forward, (from A to B,) 5 Yards; and then to retreat (from B to C) 2 Yards: If it be asked, how much he had Advanced (upon the whole march) when at C? or how many Yards he is now Forwarder than when he was at A? I find (by Subducting 2 from 5,) that he is Advanced 3 Yards. (Becauſe $+5-2=+3$.)

Less than nothing



But if, having Advanced 5 Yards to B, he thence Retreat 8 Yards to D; and it be then asked, How much he is Advanced when at D, or how much Forwarder than when he was at A: I ſay -3 Yards. (Becauſe $+5-8=-3$.) That is to ſay, he is advanced 3 Yards leſs than nothing.

- Presented a line in which a move leftwards 3 yards from A to D was ***"less than nothing"***

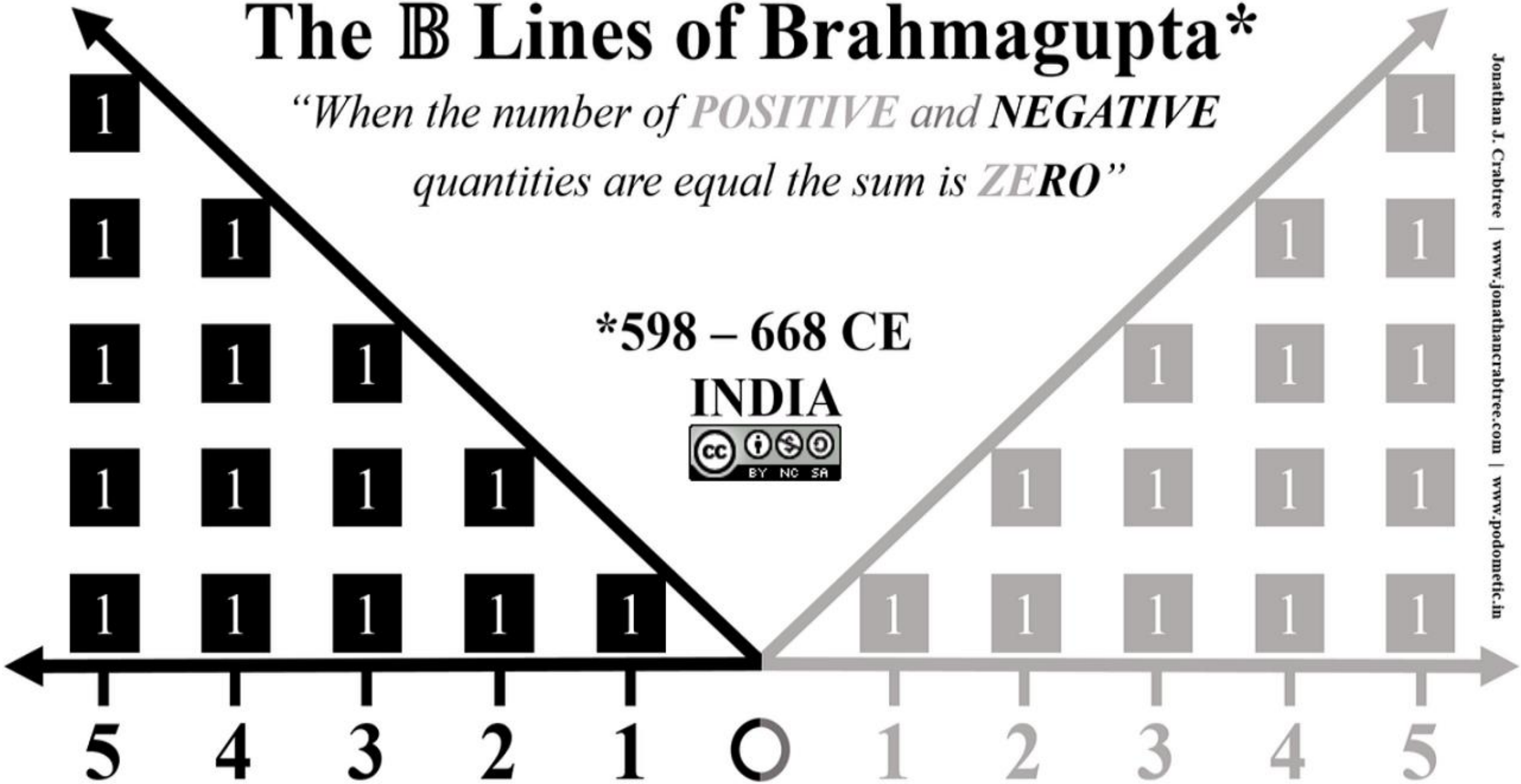


The 𝔹 Lines of Brahmagupta*

"When the number of POSITIVE and NEGATIVE quantities are equal the sum is ZERO"

***598 – 668 CE**

INDIA



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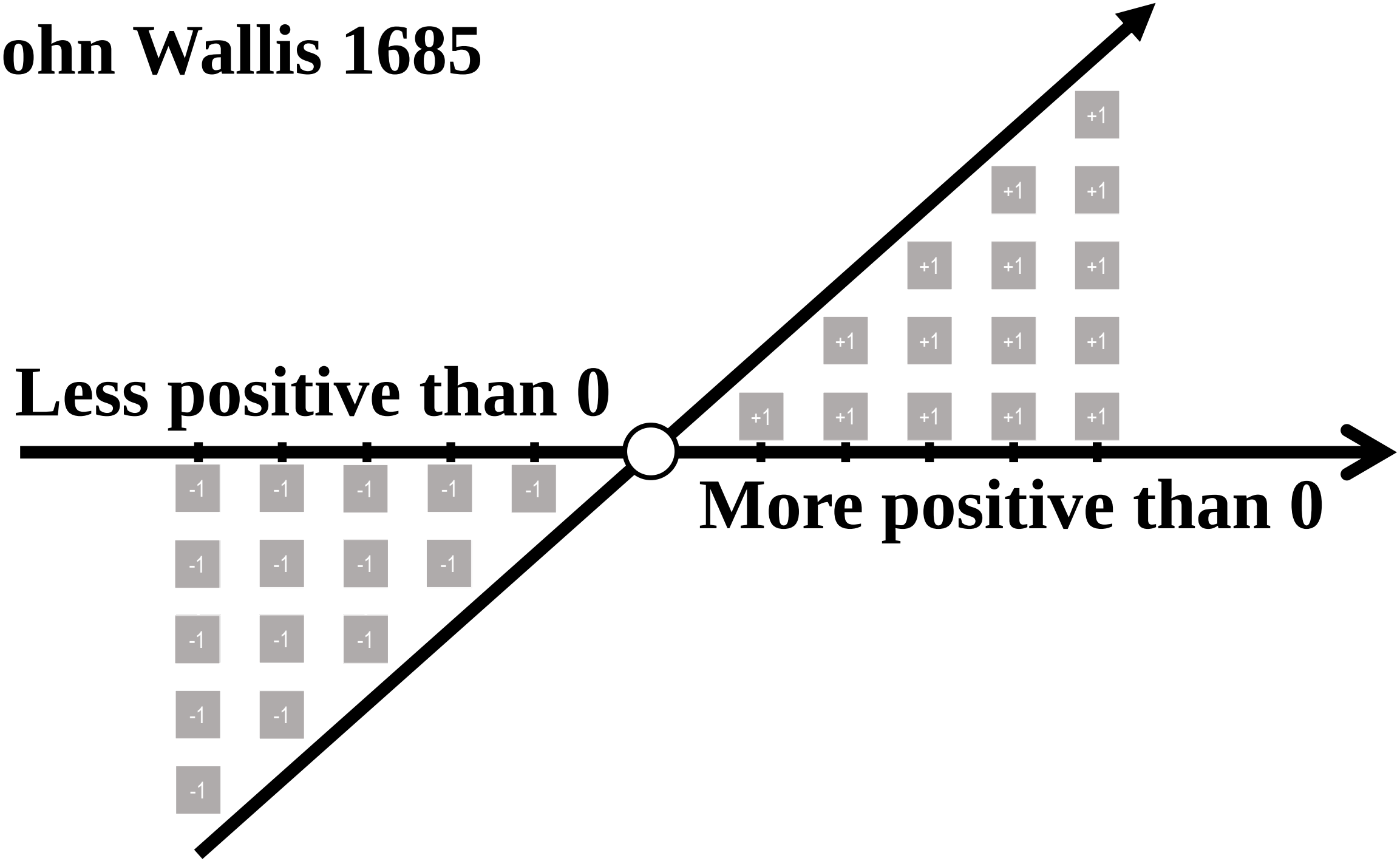
John Wallis 1685



Negative Multiplicand × Subtracting Multiplier

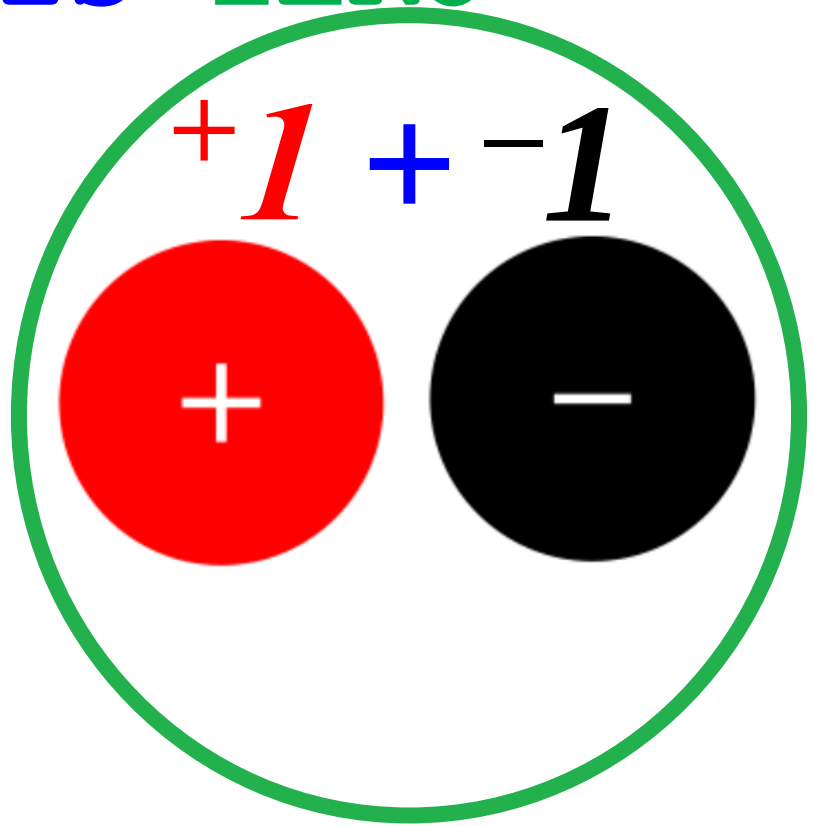
$$^{-}a \times -b$$

*^{-}a subtracted from zero **b** times*

$$^{-}1 \times -1$$

*$^{-}1$ subtracted from zero **1** time*

Brahmagupta Defined ZERO in AS4 when positive and negative are equal the sum is ZERO

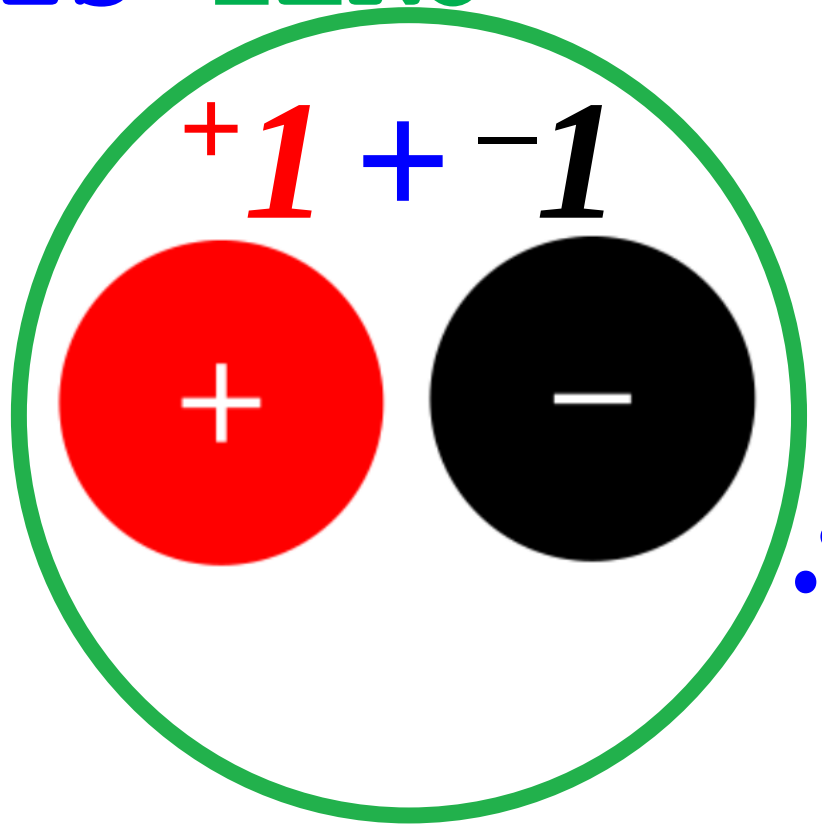


$$^{-}1 \times -1$$

$^{-}1$ subtracted from zero 1 times

Brahmagupta Defined ZERO in AS4 when positive and negative are equal the sum is ZERO

$$^{-}1 \times -1$$



$^{-}1$ *subtracted from* ***zero*** **1** *times*

now prove it equals $^{+}1$

$$\therefore \quad ^{-}1 \times -1 = {}^{+}1$$

Brahmagupta Defined ZERO in AS4 when positive and negative are equal the sum is ZERO

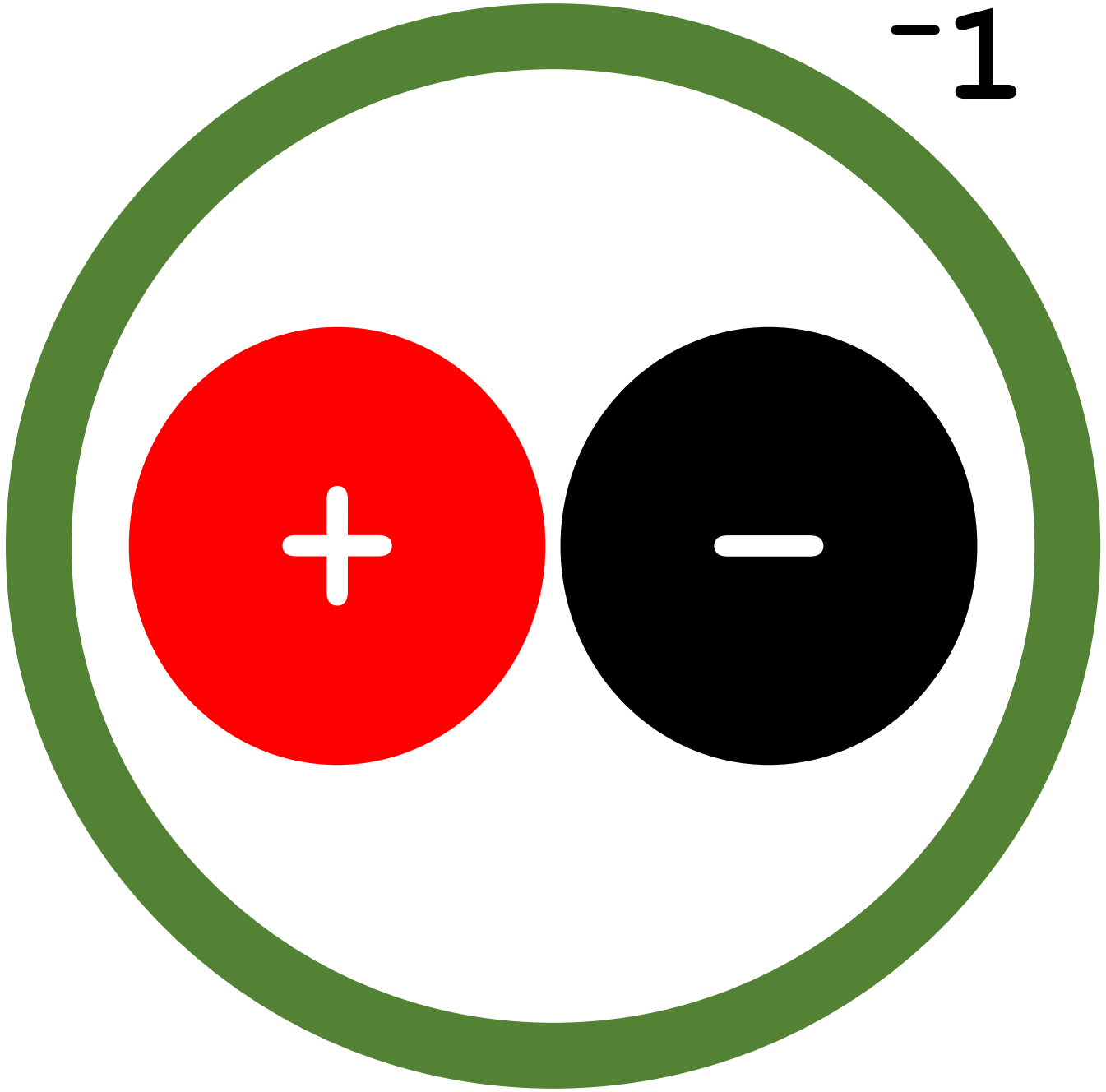
$$^{-}1 \times -1$$

$^{+}1$

$^{-}1$ *subtracted from zero* 1 *times*

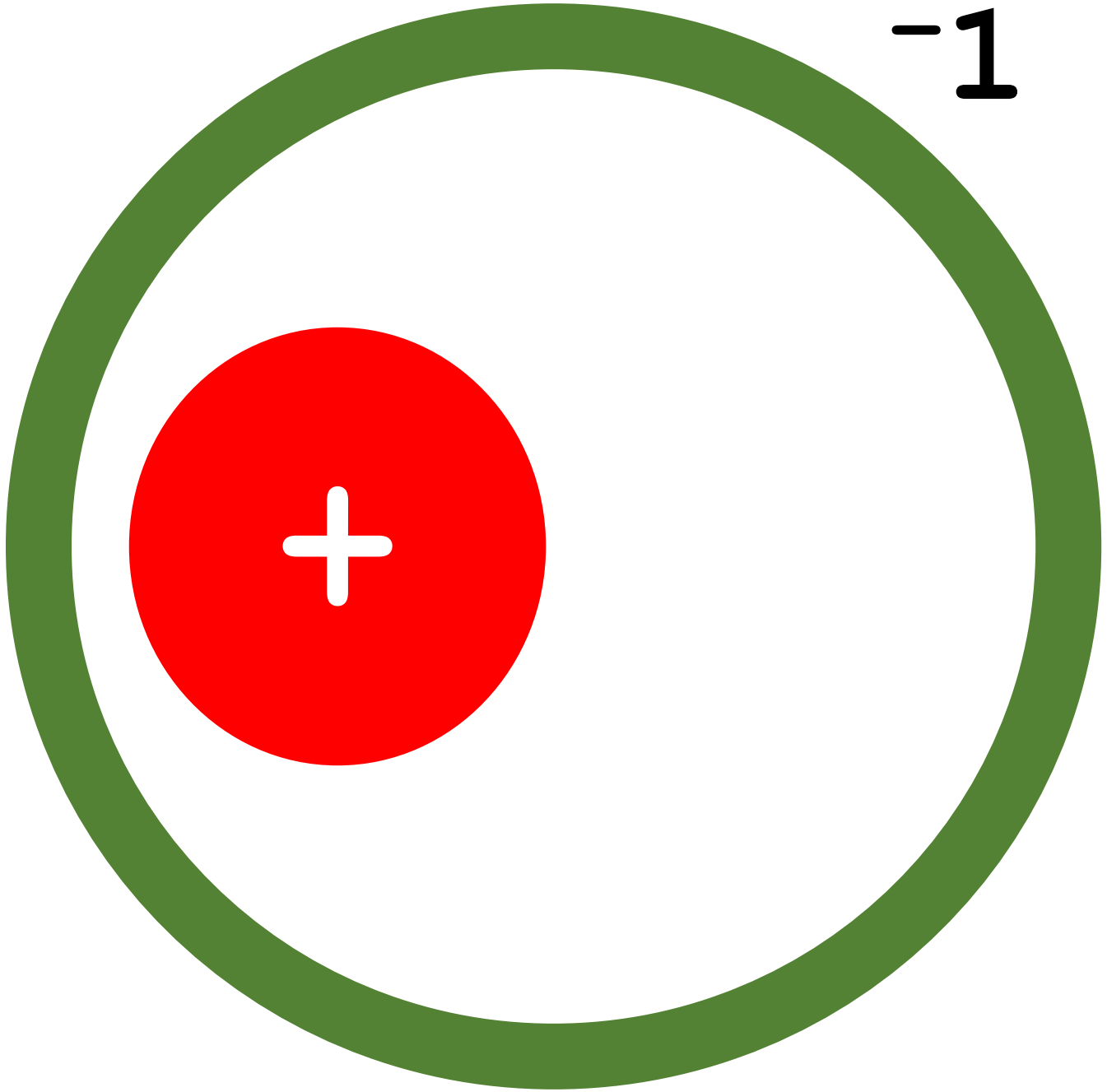
now we proved it equals $^{+}1$

$$\therefore \; ^{-}1 \times -1 = {}^{+}1$$



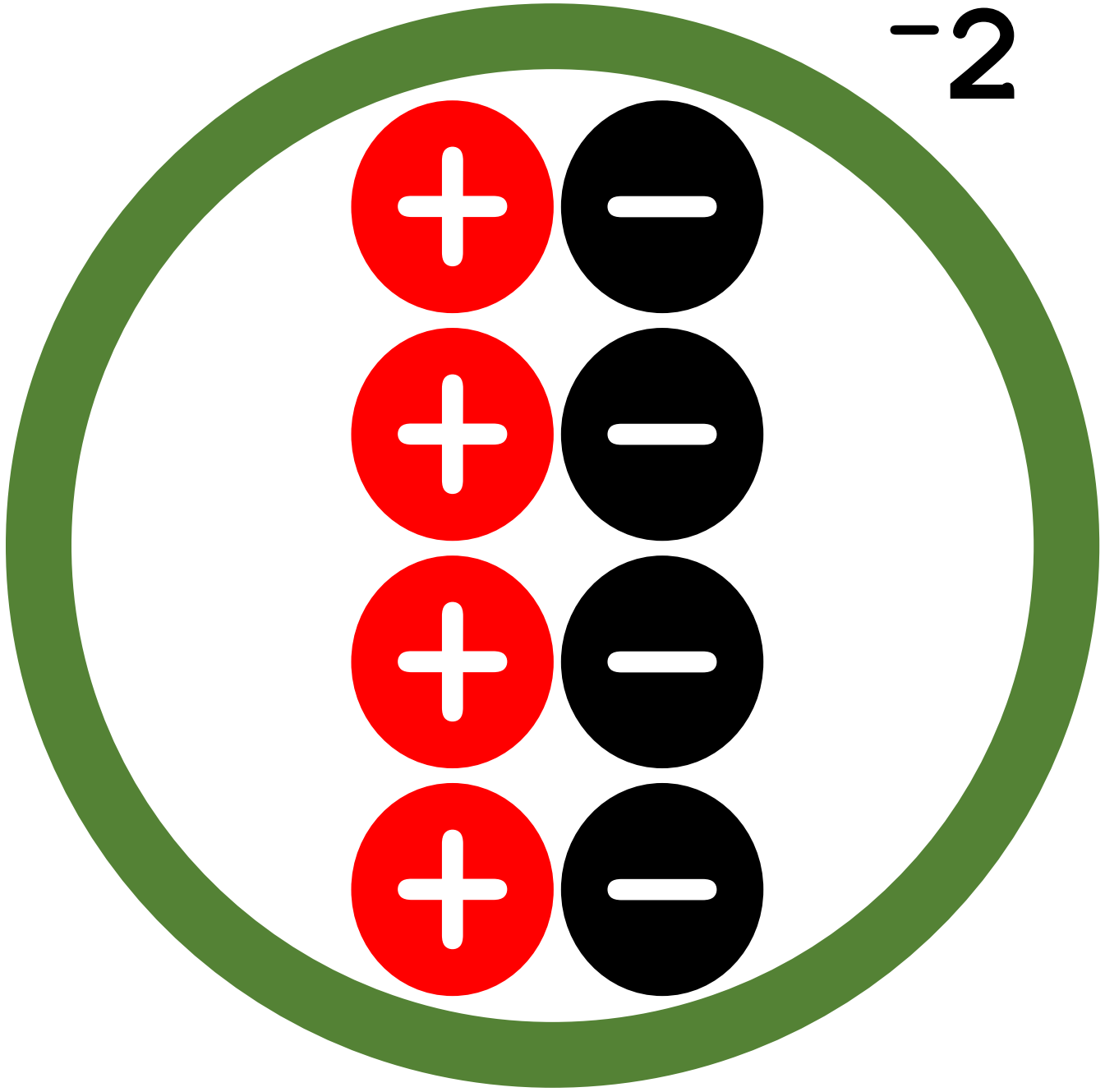
-1×-1

-1 subtracted from 0 1 time



$^{-}1 \times -1$

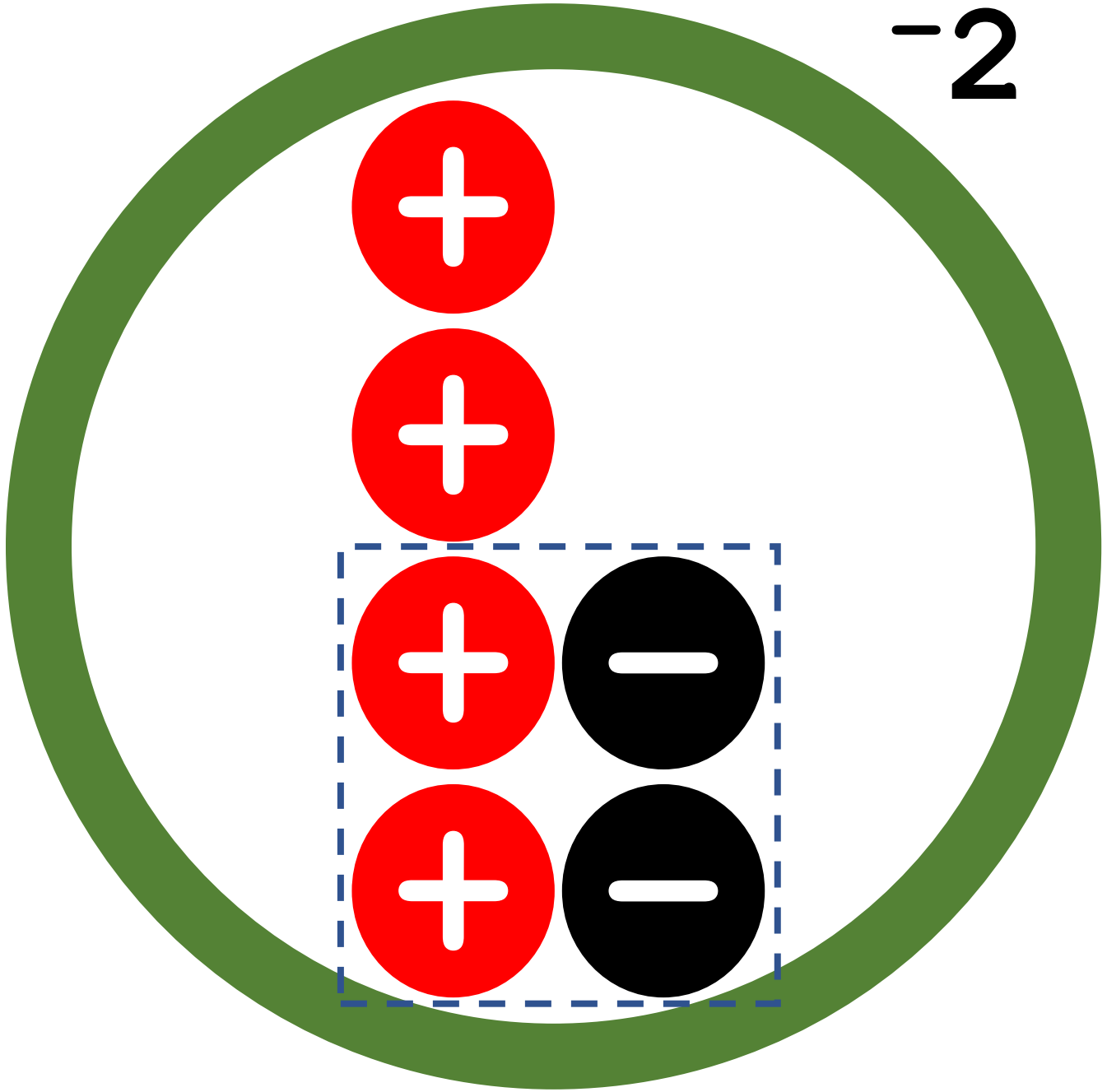
$^{-}1$ subtracted from 0 1 time equals $^{+}1$



-2×-2

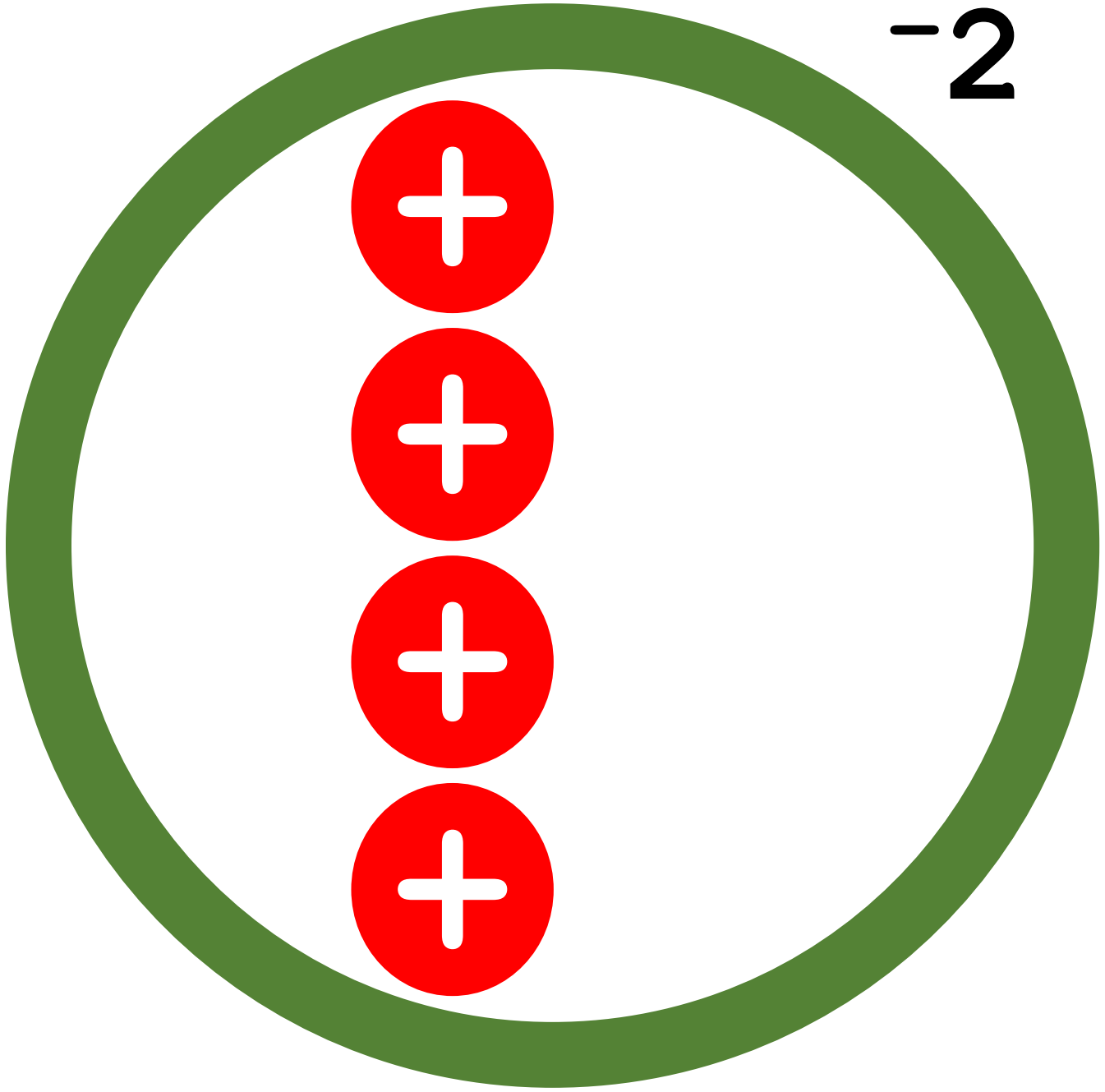
-2 subtracted

from 0 2 times



$^{-}2 \times -2$

$^{-}2$ subtracted
from 0 1 time
equals $^{+}2$



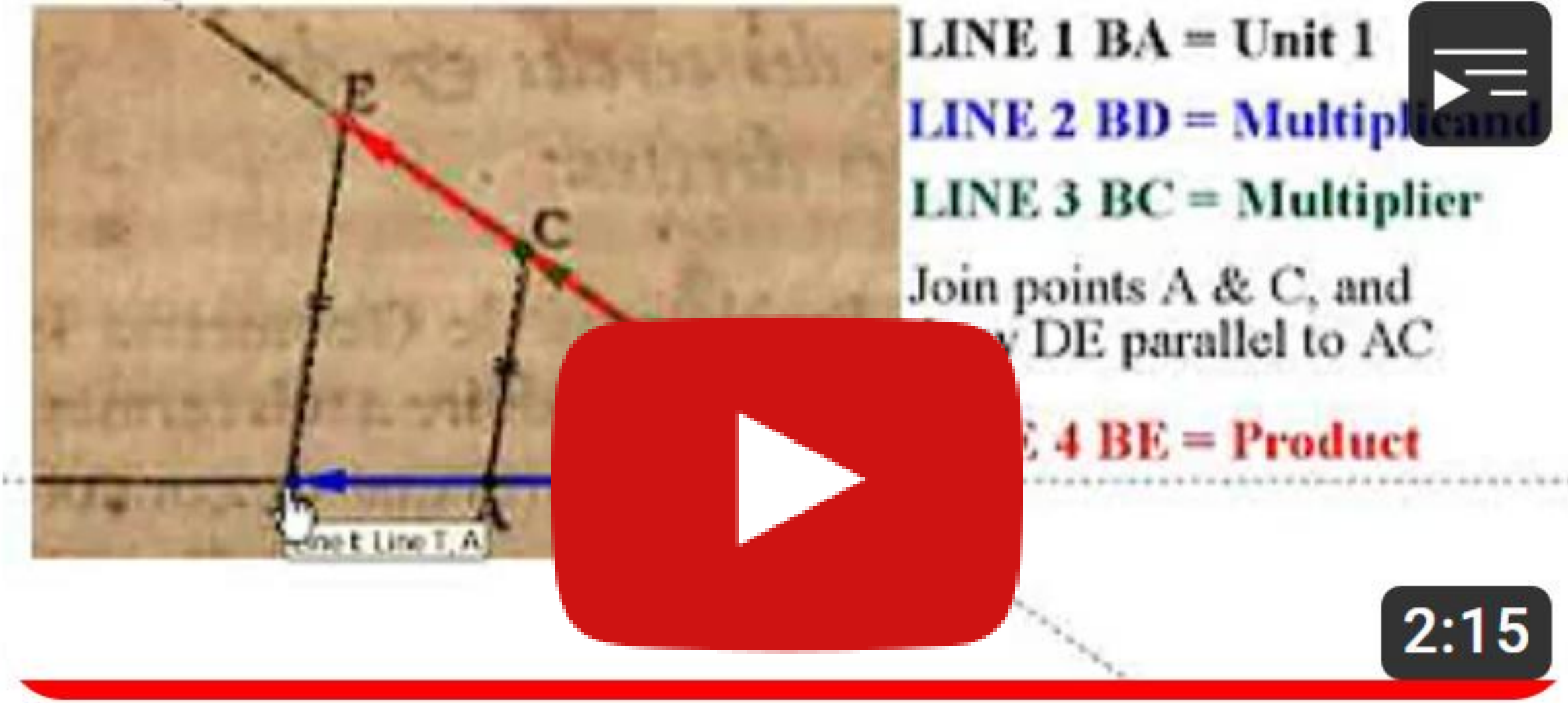
$^{-}2 \times -2$

$^{-}2$ subtracted
from 0 2 times
equals $^{+}4$

- NOTE: Via the zero=based symmetry of India, we can **build on** the 16th C. writings of Kṛṣṇa Daivajña in his Bījapallava translated by **Dr Sita Sundar Ram**.

- Let lines extending in the opposite direction of a positive line segment be negative. Then, we can go back in time to 300 BCE and update Euclid's Book VI Proposition 12!

- We discover a 'new' geometric model for **negative** × **negative** = **positive!**



See Zero & Negatives Lying Dormant Within Euclidean Geometry c. 300 BCE

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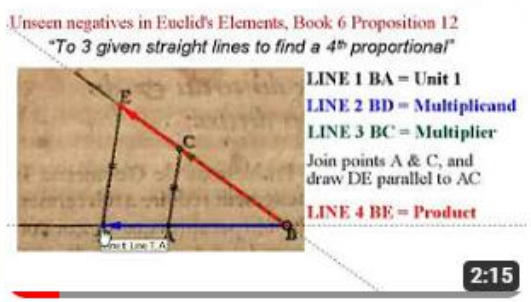

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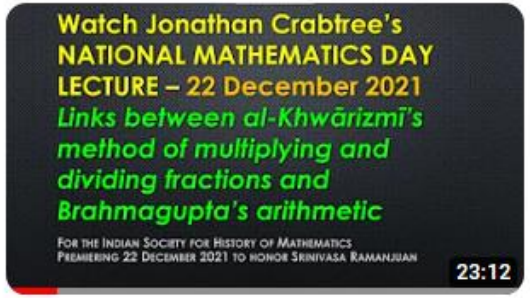

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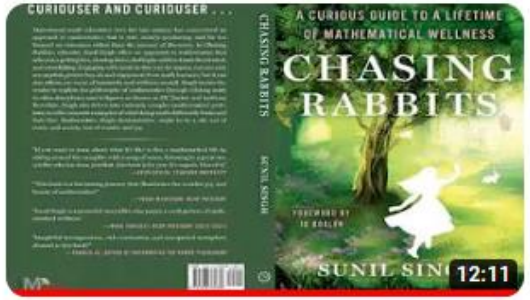

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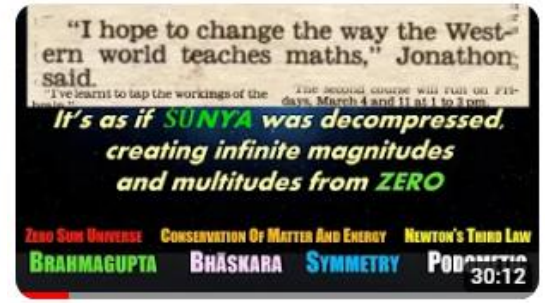

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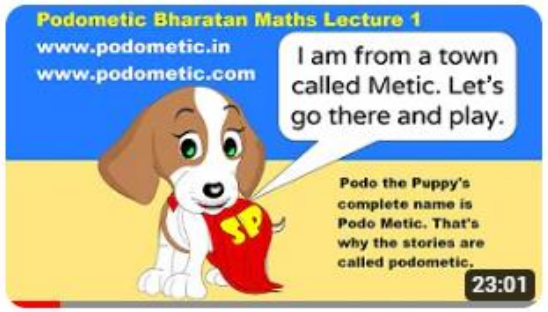

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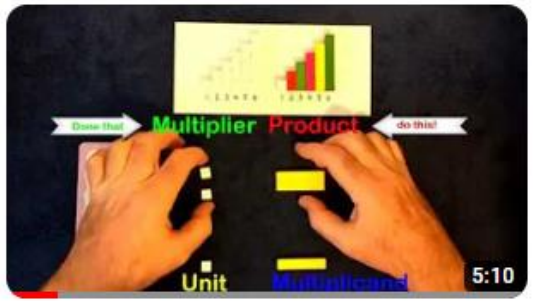

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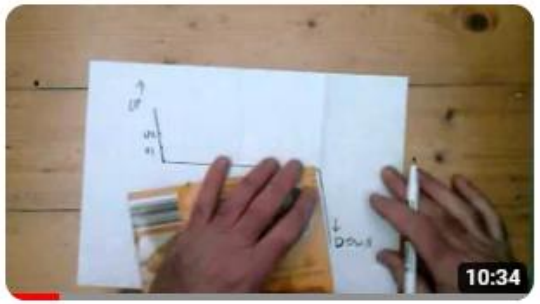

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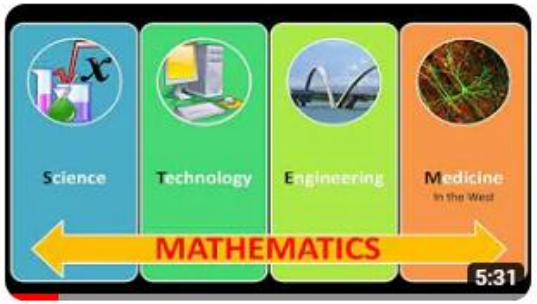

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